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MONTHLY WEATHER REVIEW

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PHYSICAL FACTORS AFFECTING THE VISIBILITY OF SMALL SMOKE COLUMNS

By George M. Byram

[Formerly of the Pacific Northwest Forest Experiment Station, United States Forest Service, August 1935]

The investigations reported in this paper were made for the Pacific Northwest region (Washington and Oregon) of the United States Forest Service for the purpose of determining the maximum distance at which fire lookouts can be depended upon to discover the smoke of small fires; but the results obtained may be of value to anyone interested in the atmospheric conditions that affect visibility.

This report is confined to a consideration of a few of the physical factors that influence the visibility of small columns of smoke. These are:

1. Atmospheric conditions.
   a. Haze brightness.
   b. Lack of transparency of the air.
2. Intrinsic brightness of backgrounds.
3. Position of sun with respect to smoke columns.
4. Shadows from low sun in valleys and canyons in mountainous regions.
5. Cloudiness of the sky.
6. Size of smoke column.

The basic data were obtained by observing the maximum distances at which small columns of smoke could be seen under different combinations of these physical factors, and by taking simultaneous measurements of

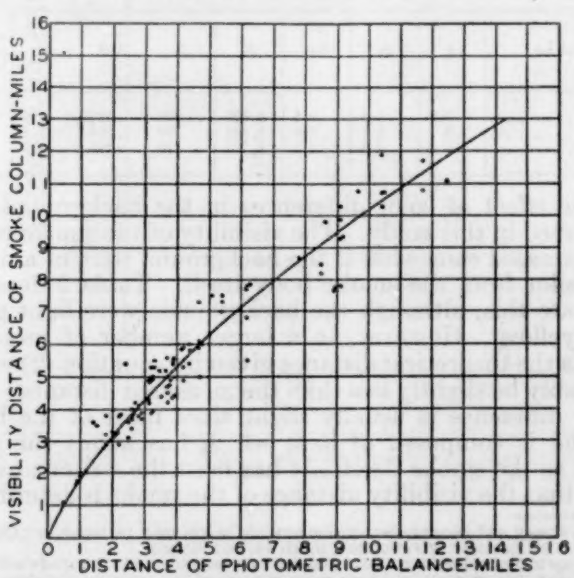

Figure 1.—Relation between the safe visibility distance of standard test smoke columns and the distance of photometric balance of the haze meter.

visibility conditions. A constant volume of smoke for the tests, similar in quantity and quality to the smoke from a small fire (approximately 200 square feet) in Douglas fir or ponderosa pine duff on a dry midsummer day, was produced by specially constructed smoke pots. Measurements of atmospheric conditions and of the intrinsic brightness of backgrounds were made with the visibility photometer and the haze meter.[1] Single col-

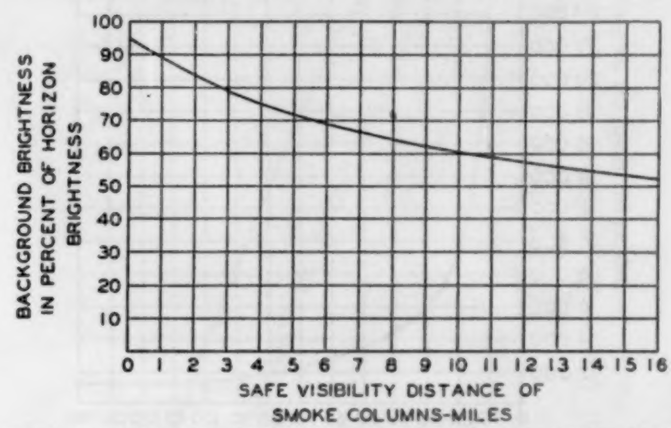

Figure 2.—Relation of the visibility distance of test smokes to the brightness of the background against which they are seen.

umns of smoke were sent up on calm days at different distances from an observation point until the maximum distance at which the smoke column could be seen was found. In all cases the maximum-visibility distance reduced 30 percent was assumed to be the safe-visibility distance. Variations due to quality of observer's eyesight were eliminated by using only one observer (the writer) throughout the study. A mirror-signal system enabled the observer to know when and where to look for the smoke so that variations due to attention and ability to find the smokes were eliminated.

Figure 1 shows the maximum distance of safe visibility of the smoke columns against dark-timbered backgrounds plotted as a function of the distance of photometric balance as indicated by the lookout haze meter.[1] Such balance is obtained when the meter is directed at a spot on the landscape which is 60 percent as bright as the sky at the horizon in the same direction. If measurements are made against dark-timbered backgrounds, it is the distance which will reduce the intensity of a beam of light passing through this distance to 40 percent of its initial value.

Figure 2 shows the background brightness at the limit of safe visibility. Values for this curve were computed[2] from figure 1. The background brightness is expressed

[1] McArdle, Richard E., A Visibility Meter for Forest Fire Lookouts, Journal of Forestry, vol. XXXIII, April 1935.
Byram, Geo. M., Visibility Photometers for Measuring Atmospheric Transparency, Journal of the Optical Society of America, vol. XXV, pp. 388-392, December 1935.
[2] By methods developed in "Visibility Photometers for Measuring Atmospheric Transparency", previously cited.

as a percent or fraction of the horizon brightness in the same direction. This is necessary because the brightness of the horizon and that of the smoke body itself both change in the same manner, and the contrast between the smoke and its haze background is independent, as will be shown, of the position of the sun.

Figure 3 gives the relative brightness of different points on the horizon as a function of their angular distances from the sun. This curve also represents the manner in which brightness of the smoke body and brightness of the haze between the observer and some point of the landscape vary with the position of the sun.

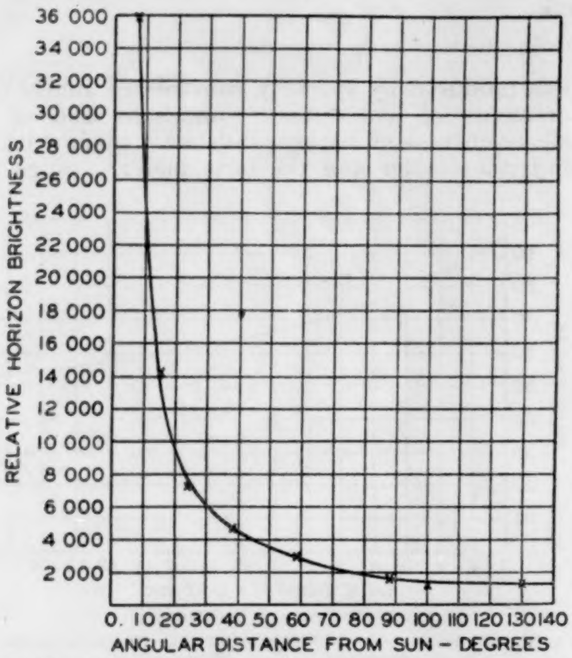

FIGURE 3.—Relation between brightness of points on the sky at the horizon and their angular distance from the sun. (Brightness of old-growth Douglas fir foliage taken arbitrarily as 100.)

Table 1 gives the relative brightness of different kinds of vegetation constituting backgrounds. The brightness of old growth Douglas fir was arbitrarily given a value of 100 and was taken as a standard for brightness measurements of other vegetation covers as well as for the horizon and haze.

TABLE 1.—*Relative brightness of different types of backgrounds*

Background type	Relative brightness
Old growth Douglas fir (used as brightness standard)	100
Ponderosa pine	140
Young Douglas fir	190
Cedar	195
Lodgepole pine	210
Bare hillsides	210
Light green brush	270-400
Bracken fern (dry)	270
Bracken fern (green)	360
Vine maple (green)	310
Vine maple (red and yellow)	470
Gray snags	690
Yellow green field grass	800

The total background brightness at the maximum safe visibility distance of the smoke column may be expressed as a function of that distance; that is, in order for the smoke to be safely visible, the maximum value that the background brightness can have is determined by the distance of the background from the observer. The complete visibility equation is

$$R(1-\rho^x)+B\rho^x=Rf(x), \tag{1}$$

where x is the visibility distance of the smoke, R is the horizon brightness (figure 3), ρ the transmission factor (percent of light transmitted per mile), and B the background brightness, various values for which are given in table 1. The left member of equation (1) is the sum of the haze brightness, $R\,(1-\rho^x)$, and the intrinsic background brightness $B\rho^x$. The function, $f(x)$, is given in figure 2. This equation is true only when the background can be assumed to be at the same distance as the smoke.

If e^{-k} (k is the optical density) is substituted for ρ, equation (1) may be written in the form

$$kx-\log\left(1-\frac{B}{R}\right)+\log\,[1-f(x)]=0, \tag{2}$$

which can be readily solved by the nomographic chart [3] in figure 4. To make the chart direct reading, the line representing the atmospheric variable was calibrated in distances of photometric balance of the haze meter instead of the optical density k. These two variables are related by the equation

$$e^{-kd}=0.40,$$

where d is the distance of photometric balance.[4]

Table 2 gives the results of three different measurements of the visibility distances of the test smokes against light backgrounds and also simultaneous measurements of factors affecting the visibility distance. In this table d is the distance of photometric balance against dark backgrounds; x_1 is the observed visibility distance of the smoke column; x_2 is the theoretical visibility distance given by equation (2); x_3 is the distance an observer should see the test smoke against a dark background with the values of R and d remaining constant; ρ is the transmission factor.

TABLE 2.—*Visibility distance of smokes against light backgrounds*

Test no.	d	x_1	x_2	R	B	B/R	x_3	ρ (percent per mile)
1	3.8	1.8	2.5	1,300	890	.685	5.8	78.5
2	5.5	6.1	6.0	1,300	370	.285	7.8	84.5
3	2.3	2.8	3.5	1,250	370	.295	4.3	67.0

The effect of color differences in the background was neglected in this study. The visibility of the smoke might be increased somewhat if the background were of a different color from the smoke body itself. Table 2 does not indicate this, although the backgrounds were light green and yellow. However, in a larger number of measurements the theoretical distance given by equation (2) would probably be slightly less than the measured distance. The color difference is usually slight since most of the background is composed of haze which has about the same color as the smoke itself. It has been the writer's experience that the visibility distance of the smoke is determined

[3] The theory and construction of nomographic charts may be found in "Design of Diagrams for Engineering Formulas", by Hewes and Seward.

[4] For the sake of uniformity all air transparency measurements in this study were made against dark backgrounds, although measurements of the visibility distances of test smokes were made against both light and dark backgrounds. If air transparency measurements are made against light backgrounds whose brightness cannot be neglected, the optical density k, and the distance of photometric balance are related by the equation

$$kd'+\log\left(\frac{0.40}{1-B/R}\right)=0.$$

To use the d' in this equation as the atmospheric variable, it would be necessary to solve for k and substitute this value in equation (2) and prepare a new chart.

more by its brightness contrast with its background than by color contrast. This seems to be especially true when the boundary between the smoke and its background is not well defined.

Curve B in figures 5 and 6 was constructed by means of the nomographic chart (fig. 4) from the data given in table 1 and figure 3. The radii of the curves designated B in figures 5 and 6 represent the visibility distances of small smokes in the sunlight as seen from the observation point O. Since these curves are nearly circular, to construct them it is necessary to find only their maximum radii toward and away from the sun (from their displaced center). Table 3 gives several pairs of these maximum radii of curve B for different times and conditions.

From figures 5 and 6 or table 3 it can be seen that the visibility distance of small smoke columns is greatest at small angular distances from the sun, that is, when the observer faces the sun. This finding is contradictory to the opinion formerly held by nearly all foresters, but it has been confirmed by a statistical analysis of fire records shown in table 4 which indicates that forest-fire lookouts do discover more fires in the sector facing the sun than they do in the sector away from the sun.

It can be shown from theoretical considerations that the visibility distance of smoke bodies should be greatest at small angular distances from the sun. In figure 7 an observer at O is at a distance x from a smoke body which is seen against a background of brightness B. The contrast C between the smoke and the background against which it is seen is given by the equation

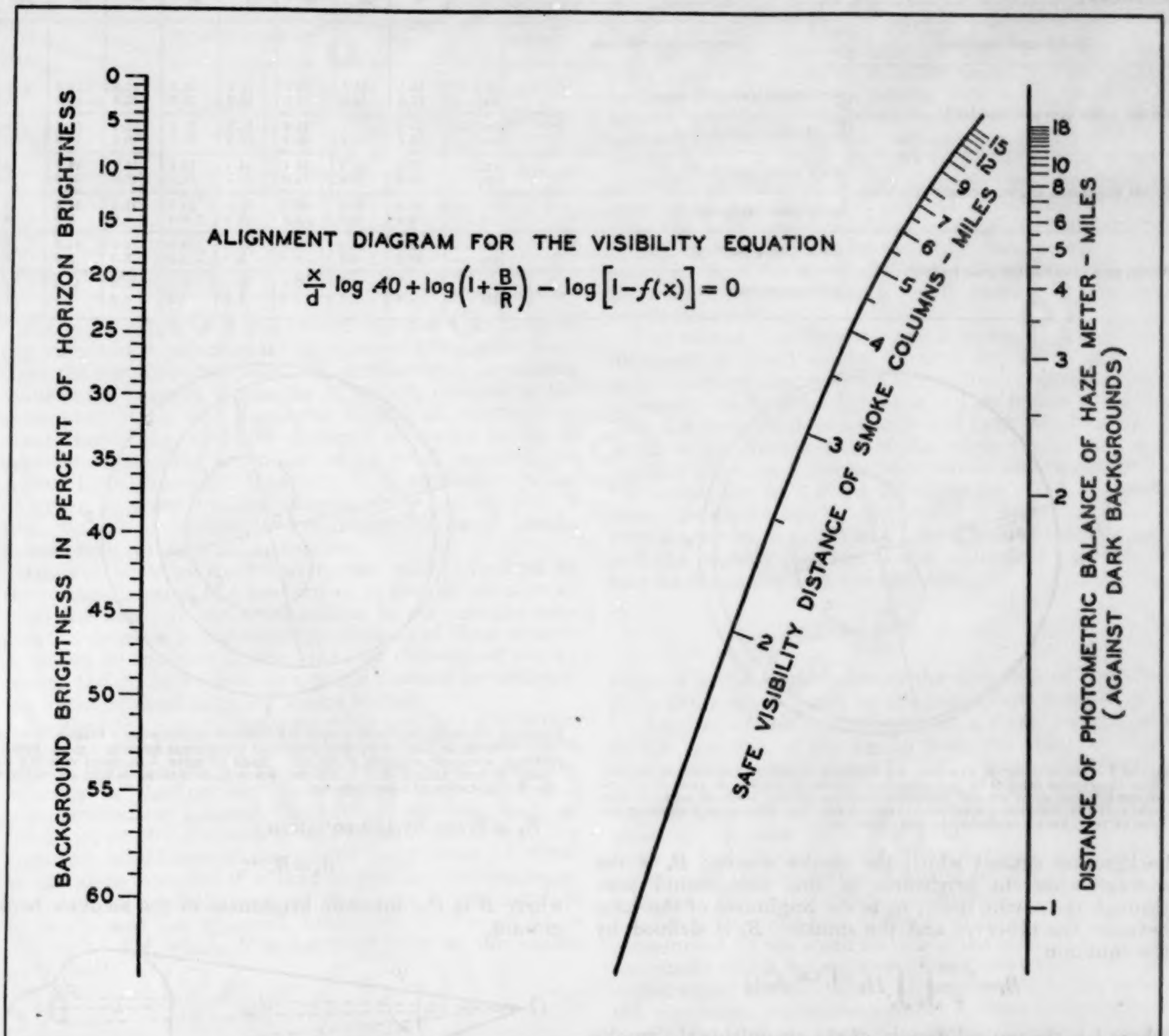

FIGURE 4.—Solutions of the visibility equation are found from this chart by connecting, with a straightedge, a point on the line representing the distance of photometric balance of the haze meter to a point on the line representing background brightness. The intersection of this line with the middle curve gives the visibility distance of the smoke column.

$$C=\frac{B_s-B_b+B_a}{B_s+B_b+B_a},\qquad(3)$$

where B_s is the average apparent brightness of the smoke body seen from O; B_b is the apparent brightness of the

TABLE 3.—*Pairs of maximum radii of safe visibility toward the sun and away from the sun, May 21 to July 21. Latitude 45° N. (B is the relative intrinsic brightness of the background, table 1, against which the smoke is seen; d is the distance of photometric balance of the haze meter; x_1 is the maximum safe radius of visibility in the direction of the sun; x_2 is the maximum safe radius of visibility away from the sun)*

LATITUDE 45° N.

Time of day {a. m.			12:00	11:00	10:00	9:00	8:00	7:00	6:00	5:00
Time of day {p. m.			12:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00
Sun's altitude			67°	63°	56°	47°	37°	26°	16°	6°
Sun's azimuth			0°	32°	55°	74°	85°	96°	106°	115°
Background brightness	Atmospheric conditions									
B=120, yellow pine and Douglas fir	d=18 miles (clear day)	x_1	14.5	14.6	14.6	14.7	14.7	14.8	14.9	15.0
		x_2	14.0	14.0	14.0	13.9	13.9	13.8	13.8	13.8
	d=12 miles (hazy day)	x_1	11.2	11.2	11.2	11.3	11.4	11.4	11.4	11.5
		x_2	10.7	10.7	10.7	10.6	10.6	10.6	10.6	10.6
B=300, vine maple, bracken fern, and light brush	d=18 miles (clear day)	x_1	13.9	13.9	14.1	14.1	14.3	14.5	14.7	14.9
		x_2	12.4	12.2	12.0	11.7	11.7	11.6	11.6	11.6
	d=12 miles (hazy day)	x_1	10.5	10.6	10.7	10.9	11.1	11.2	11.4	11.5
		x_2	9.4	9.4	9.3	9.2	9.1	9.0	9.0	9.0
B=500, snag areas and dry grass lands	d=18 miles (clear day)	x_1	12.7	12.9	13.3	13.6	13.9	14.3	14.7	14.9
		x_2	10.0	9.8	9.5	9.2	9.2	8.9	8.9	8.9
	d=12 miles (hazy day)	x_1	9.7	9.9	10.1	10.4	10.7	11.0	11.3	11.5
		x_2	7.8	7.7	7.6	7.4	7.3	7.2	7.1	7.1

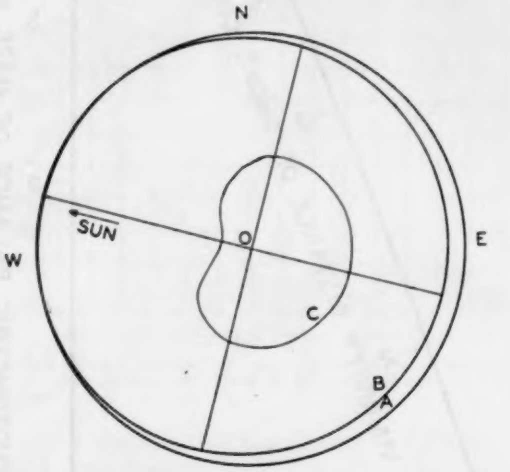

FIGURE 5.—Visibility curves on a clear day (distance of photometric balance, 18 miles) from observation point O for backgrounds of Douglas fir for 6 p. m. June 21, altitude of sun 16°, azimuth of sun 106° (measured from the south). Radii for curve A represent visibility distances of small smokes on a cloudy day; curve B, on a cloudless day; and curve C, smokes in shadow on a cloudless day.

background against which the smoke is seen; B_a is the average apparent brightness of this background seen through the smoke itself; B_h is the brightness of the haze between the observer and the smoke. B_s is defined by the equation

$$B_s=\frac{e^{-kx}}{\psi}\int_\psi\int_0^l He^{-\int_0^u k_s du}\,du\,d\psi$$

where k is the optical density of the air outside the smoke body, x is its distance from the observer, ψ is the solid angle it subtends at the observer's eye, l is its diameter at any point in the direction of x, and u is the distance in the direction of x of a small volume element of the smoke body measured from that part of the surface of the smoke which is visible from O. The variable H represents the amount of light scattered per unit distance inside the smoke body, and is a function of u and ψ as well as the position of the light sources illuminating the smoke. The optical density k_s inside the smoke body is also a function of u and ψ.

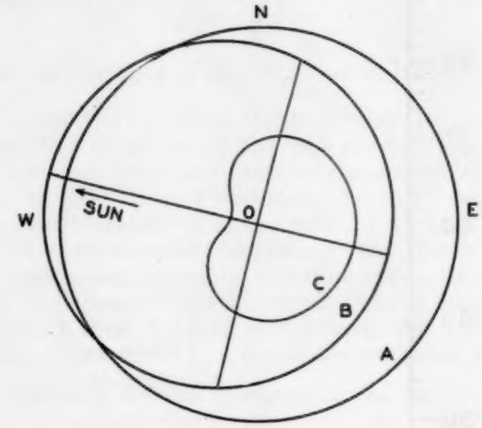

FIGURE 6.—Visibility curves on a clear day (distance of photometric balance, 18 miles) from observation point O for backgrounds of dry grass or snags for 6 p. m. June 21, altitude of sun 16°, azimuth of sun 106°. Radii for curve A represent visibility distances of small smokes on a cloudy day; curve B, on a cloudless day; and curve C, smokes in shadow on a cloudless day.

B_b is given by the equation

$$B_b=Be^{-kx},$$

where B is the intrinsic brightness of the smoke's background.

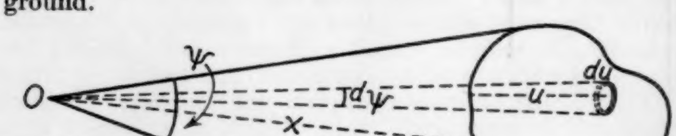

FIGURE 7.

B_a is given by the equation

$$B_a=\frac{Be^{-kx}}{\psi}\int_\psi e^{-\int_0^l k_s du}\,d\psi$$

The haze brightness B_h is given by the equation

$$B_h = R(1 - e^{-kx}),$$

where R (fig. 3) is the horizon brightness in the direction of x.

TABLE 4.—*Effect of sun position on the discovery of fires by lookouts Based on all the lookout-discovered fires in the national forests of Oregon and Washington over a 4-year period*

Altitude of sun in degrees	180° sector toward sun			180° sector away from sun			360° around lookout	
	Number of fires discovered		Average discovery distance	Number of fires discovered		Average discovery distance	Total fires discovered	
	Number	*Percent*	*Miles*	*Number*	*Percent*	*Miles*	*Number*	*Percent*
0°–29°	507	62	8.8	306	38	7.5	813	100
30°–44°	401	63	9.5	235	37	8.5	636	100
45°+	768	64	9.6	430	36	9.3	1,198	100
All angles combined	1,676	63	9.3	971	37	8.5	2,647	

Since the values of R and also H increase with decreasing values of θ, the angular distance of the smoke body from the sun, the contrast C will increase with decreasing values of θ, because the terms B_s and B_h increase in the same proportion, and the terms B_b and B_a remain constant; hence the visibility distance of smoke bodies is greatest when they are observed at small angular distances from the sun. However, it is advisable for an observer to wear smoked glasses when looking into a low sun, since Fechner's psychophysical law[5] breaks down under strong light intensities.

Objects such as trees and houses cannot be seen as far in the direction of a low sun as in the direction away from the sun. If the transmission factor remains constant, a decrease in the visibility distance of these objects indicates an increase in the visibility distance of smoke bodies and could be used as a rough method for estimating visibility conditions for smoke bodies.

Toward the sun, in early morning and late afternoon, in mountainous country, a large part of the visible land surface is in shadow. The range of visibility for smoke columns in shadow can be deduced from theoretical considerations as follows: The ratio of the brightness of the haze, at the distance of maximum visibility, to the apparent brightness of the smoke body must be equal to the same function of x that is used in deriving equation (2). The brightness of the haze background is $R(1-\rho^x)$, and the apparent brightness of the smoke is $R(1-\rho^x)+K\rho^x$, where K is the brightness of the smoke body itself:

$$\frac{R(1-\rho^x)}{R(1-\rho^x)+K\rho^x} = f(x). \tag{4}$$

This equation may be written

$$\frac{Kf(x)}{R[1-f(x)]} = e^{kx} - 1. \tag{5}$$

Since the value of kx is usually small, equation (5) may be written approximately

$$kx - \frac{Kf(x)}{R[1-f(x)]} = 0, \tag{6}$$

[5] Helmholtz, Physiological Optics, vol. II, pp. 172-181.

which can be solved by nomographic chart methods. The numerical value of K is 240.

The small heart-shaped curves (designated C) in figures 5 and 6 represent the theoretical visibility distances of smoke columns in shadow, as computed from equation (6). Full experimental proof of the accuracy of these curves is not yet available because only a few tests have been made with the smokes in shadows; hence they should not be considered as reliable as the curves for the range of visibility for smoke columns in full sunlight, which are based on a large number of actual tests.

Equation (6) does not hold for days when the smoke layer over a given region is rather dense and fairly deep, because the oblique rays coming from a low sun may be almost completely absorbed before reaching the earth and will have little effect in casting deep shadows. A test smoke in one of these shadows could be seen at a much greater distance than in the shadows resulting from the usual strong sunlight. If the sun is completely blotted out, the test smoke is illuminated almost entirely by light from the sky, and its visibility distance curve is the same as that for a cloudy day. Conditions like this, however, constitute only a small fraction of the usual smoky weather.

The curves A in figures 5 and 6 represent the visibility distances of small smoke columns on cloudy days. It will be noticed that they are larger than on cloudless days, especially on light backgrounds. This is due to the fact that the equivalent point source of light which would be equal to the illumination of the whole cloudy sky in its lighting effect on a smoke body would not be situated at the zenith but at a point infinitely far away, about 50° from the smoke body. If the sky is uniformly clouded over it may be regarded as a hemisphere of infinite radius and the angular position of the equivalent point source may be determined by the equation

$$f(\theta)_{\text{eff.}} = \frac{1}{2}\int_0^{\pi} f(\theta) \sin\theta d\theta, \tag{7}$$

where θ is the angle between the direction of the smoke body and a circular ring on the hemisphere formed by the intersection of the hemisphere and a plane perpendicular to the direction of the smoke from the observer; $f(\theta)$ is the function given in figure 3; $f(\theta)_{\text{eff.}}$ is the effective value of this function for the equivalent point source. The angular position of this source corresponding to $f(\theta)_{\text{eff.}}$ given by equation (3) is about 50°. This would be the same as looking into a rather low sun, and the visibility distance of the smoke body would be somewhat greater than the average distance for a cloudless day. It can also be shown that one-half of the brightness of the smoke is contributed by the small section of the clouded sky behind the smoke which has an area of only one-seventh the area of the whole clouded sky. Measurements of the ratio of the vegetation brightness and the horizon brightness on a cloudy day give the same ratio that is obtained on a clear day from measurements of the vegetation brightness and the horizon brightness at a point 50° from the sun.

Although the curves for the visibility distances of smoke bodies in figures 5 and 6 are based on the standard smoke test curve (fig. 1), the radii of these curves may be interpreted as being distances of approximately equal visibility for smokes larger than the small standard smokes. This last interpretation might be more useful since it would not connect visibility conditions with any given size of smoke volume.

The visibility distance of a smoke body having a mean diameter D times that of the standard test smoke may be found by writing the visibility equation in the form

$$\frac{x}{d}\log 40+\log(1-B/R)-\log\left[1-f\left(\frac{x}{D}\right)\right]=0,$$

where x is the visibility distance and d the distance of photometric balance. A few solutions of this equation for x (for dark backgrounds) with different values of D are given in table 5.

TABLE 5

d (Distance of photometric balance in miles)	x (Visibility distance in miles)			
	$D=1$	$D=4$	$D=6$	$D=8$
8	8.6	13.2	14.8	15.8
12	11.5	16.2	19.8	21.6
16	14.0	21.4	24.4	26.3

If a standard size of test smoke is observed through binoculars, D becomes the magnification (in diameters) of the binoculars.

It can be shown that the small test smoke might be visible at a distance of 65 or 70 miles if the transmission factor were 100 percent. However, this can never happen, because even on the clearest days each mile of the lower atmosphere absorbs and scatters 3 or 4 percent of the light traveling through it. Thus, the haze resulting from this scattering, as well as the decrease in the smoke's actual brightness, causes a tremendous loss in visibility distance, even under the most favorable conditions.

CONCLUSIONS

1. Small smoke columns can be seen farther when the observer is looking into a low sun than when the observer has the sun at his back. Trees, houses, and similar objects cannot be seen as far toward a low sun as they can away from the sun.

2. The locus of the position of a smoke column in sunlight at the maximum distance of visibility from an observation point is approximately a circle. The observation point is displaced from the center for light backgrounds, but moves nearer the center for dark backgrounds. The radii of such curves increase as the brightness of the background decreases.

3. The visibility distance does not change greatly with intrinsic background brightness in the direction of a low sun, because the haze in that direction is always many times brighter than any natural background.

4. From indirect measurements and theoretical considerations it appears that smoke columns can be seen farther on cloudy days than on clear days, the difference being much greater against light backgrounds than against dark backgrounds. Opaque objects such as trees cannot be seen as far on cloudy days as on cloudless days.

5. For all practical considerations, the safe visibility distance of smoke columns in shadows appears to be zero in the direction of a low sun.

6. Small changes in the size of a smoke body do not cause appreciable changes in its visibility distance.

7. In very clear weather small changes in atmospheric conditions will result in large changes in visibility distance.

DESTRUCTIVE EASTERLY GALES IN THE COLUMBIA RIVER GORGE, DECEMBER 1935

By D. C. CAMERON and ARCHER B. CARPENTER

[Weather Bureau, Portland, Oreg., August 1936]

Several times each winter the easterly winds in the Columbia River Gorge reach gale force, and continue at that velocity for a week or 10 days, and in some instances for nearly a month (1) (2). In December 1935 the easterly winds reached such a force that all wind instruments at Crown Point, Oreg., were completely carried away.

This tremendous flow of air is a result of deepening of nocturnally cooled air collected over the Columbia and Snake River Basins, which, like the water in these rivers, finds its way out through the Columbia River Gorge, a natural water-level route through the Cascade Range.

Any cessation of cyclonic activity in this large inland basin permits rapid cooling, by nocturnal radiation, of the polar Pacific air which normally is present. This cooling soon builds up a deep, cold layer, filled with low stratus clouds and fog; and the air flow westward through the gorge increases in proportion to the depth of the cold air (3) (4). Occasionally a small amount of transitional polar continental (N_{pc}) air which has spilled westward through the passes in the Rocky Mountains adds to this drainage. When this occurs a drop is noticed in the temperature and dew points in the gorge, and an increase is noted in the wind velocities. Such a combination of air drainage was sufficient on December 20, 1935, to cause considerable destruction at Crown Point, Oreg., and elsewhere in the western gorge area.

The ratio between the pressure gradient from Hood River to Portland, Oreg., and the easterly winds at Cascade locks and Crown Point is quite constant, as may be seen from figure 1. The top and bottom curves on the graph represent *easterly* wind velocities *above* the neutral lines, and *westerly* wind velocities *below*. The upper and lower curves are for Crown Point and Cascade locks, respectively. The center curve represents difference in pressure from Hood River to Portland, with plus values when the pressure gradient was directed from Hood River toward Portland, and minus values when the reverse occurred.

Pilots using this airway estimated wind velocities at 4,000 feet to be about 30 miles per hour when the surface velocities averaged about 50 miles per hour. The pilots did not fly in this air stream, as it was extremely turbulent; the estimate was based on the very rapid rate at which clouds, from the upper portion of the inland lake of cold air just below the inversion, were flowing westward over a 4,000-foot ridge. The pilots flying this route were amazed as they watched these clouds being carried violently into the gorge and dissipated. The top of the stratus clouds east of the Cascade Range was reported at a maximum of approximately 5,000 feet. This maximum was reached after the addition of the N_{pc} air. The previous top was usually between 3,300 and 4,500 feet.

Lowering of the cold air top east of the Cascade Range was partly counteracted by radiation cooling at the top of the cloud layer in the cold air, and by radiation cooling on the mountain slopes rising above the lake of cold air. Small additions of N_{pc} air coming westward through the passes in the Rocky Mountains temporarily increased the depth of the cold air, and increased the flow through the gorge.

A rough estimate of the magnitude of this flow may be made. The narrowest part of the gorge, near Cascade locks, has a cross section below 4,000 feet of about 4.1 square miles. Assuming an average velocity of 35

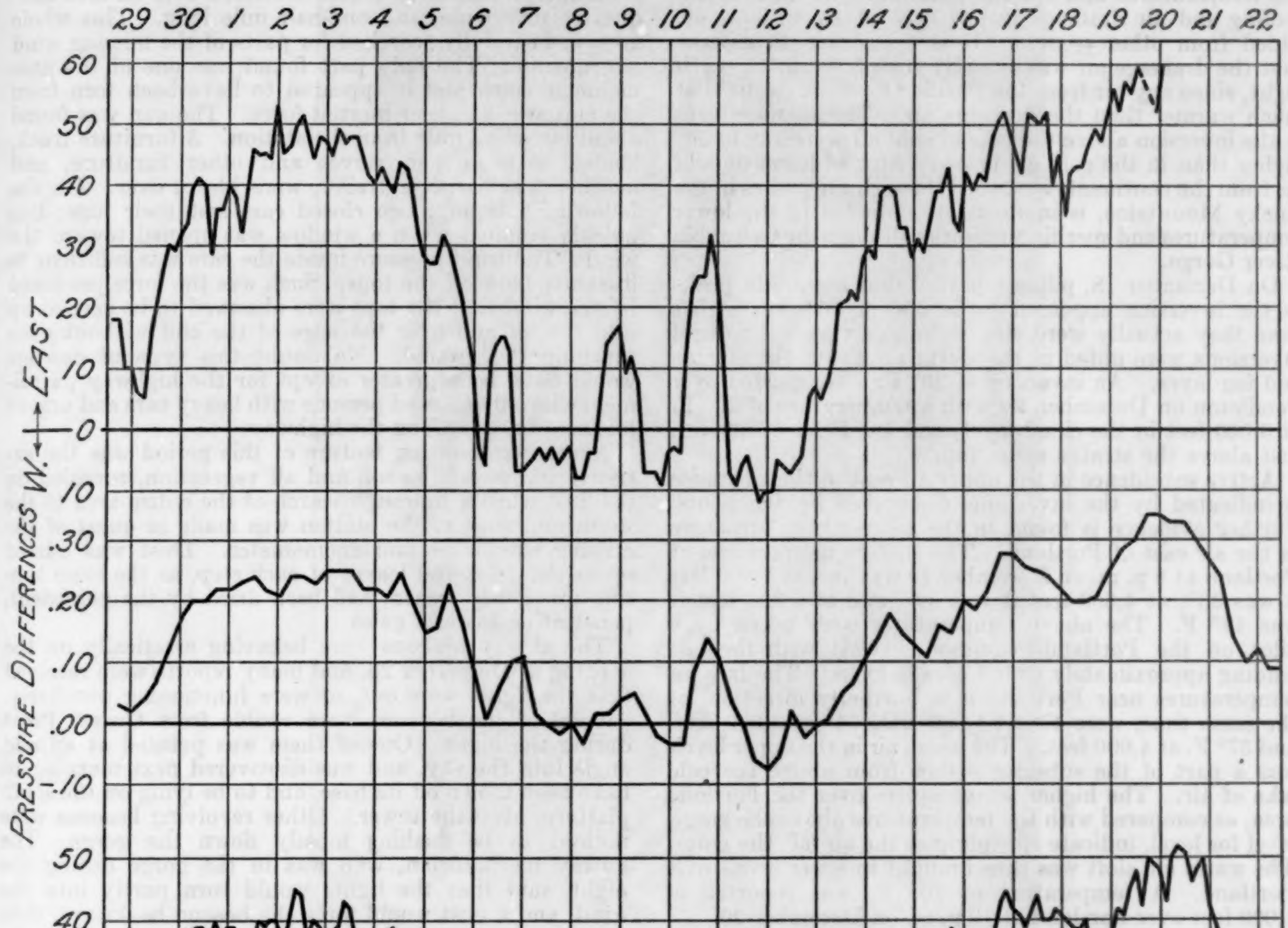

FIGURE 1.—Upper curve: Crown Point, smoothed hourly velocities, November 29, 1935, until destruction of anemometer at 3 p. m., December 20. The gorge winds are divided into easterly and westerly component values, the neutral line representing the shift in wind. Middle curve: Pressure differences, between Hood River and Portland, Oreg., distance 59 miles. Positive values represent higher pressure at Hood River, negative values lower. Lower curve: Cascade locks, smoothed hourly velocities, November 29, 1935, to December 22, inclusive. Winds divided into easterly and westerly component values, similar to Crown Point. Pressure difference in hundredths of inches. Wind velocities in miles per hour.

m. p. h. through this section, the discharge of air is 3,444 cubic miles per day.

This discharge would produce a lowering of approximately 73 feet per day over the 248,438 square miles east of the Cascade Range, drained by the Columbia and Snake Rivers. Volume has been used in the above estimates because the surface of the area exposed to radiation varies from nearly sea level to over 10,000 feet on some of the mountain slopes, making it difficult to arrive at anything more than a rough estimate. The magnitude of lowering necessary to counteract the additions of cold air is therefore conservative, since much of the radiation took place at elevations where the air was of less density than that which flowed out through the gorge.

The temperatures at Crown Point were between 30° F. and 34° F., and the specific humidities were between 2.9 and 3.5 parts per thousand during the period of easterly wind used in the calculations above. The constancy of the temperatures and specific humidities would indicate cooling and air drainage in one type of air without air added from other sources. It is reasonable to assume that the drainage air was actually cooled 10° to 15° each night, since any air from the Pacific Ocean would be that much warmer than the drainage air. The temperatures in the inversion above the lake of cold air were 15° to 26° higher than in the cold air below. Any addition of cold air from the continent, westward through the passes in the Rocky Mountains, is immediately detected in the lower temperatures and specific humidities through the Columbia River Gorge.

On December 18, pilots reported that mountain peaks in the inversion appeared to be 500 or 600 feet higher than they actually were, due to mirage effects. Several inversions were noted in the warm air above the stratus and fog layer. An inversion of 26° F. was reported over Pendleton on December 18, with a temperature of 20° F. at 3,000 feet in the cloud layer, and 46° F. at 5,700 feet, just above the stratus cloud top.

Active subsidence in the upper air east of the Cascades is indicated by the inversions discovered by the pilots. Further evidence is found in the temperature structure in the air east of Portland. The surface temperature at Portland at 6 p. m. on December 19 was 36°, at 1,000 feet it was 33°, at 4,000 feet it was 39°, and at 5,000 feet it was 42° F. The above temperatures were taken by a pilot on the Portland-Pendleton airway, with the last reading approximately over Cascade locks. The free air temperatures near Portland in a northerly direction, at the same time, were 47° at 1,800 feet, 64° at 3,000 feet, and 57° F. at 4,000 feet. The warm air in the upper levels was a part of the subsidence flow from above the cold lake of air. The higher temperatures over the Portland area, as compared with the temperatures above the gorge, level for level, indicate spreading as the air left the gorge. The warm air aloft was thus brought to lower levels over Portland. A temperature of 70° F. was reported at 4,000 feet over Portland at 10 p. m. on December 20.

On December 19 the lake-level of the cold air was increased by addition of N_{PC} air coming westward into the basin through the passes in the Rocky Mountains. This was both colder and drier than that formerly flowing through the gorge, and the pressure differences from Hood River to Portland were correspondingly increased as indicated on figure 1. The average hourly velocities reached a peak of 57 miles per hour at Crown Point, and 48 miles per hour at Cascade locks. Gusts of 79 miles per hour were measured at Crown Point before the power lines were carried away and made it impossible to use the wind indicator. A further increase in the wind and in the gusts on December 20 finally carried away the wind vane and the anemometer.

The position of the house at Crown Point in relation to the contour of the rocky promontory is such that the wind flow is decidedly upward from the steep east and northeast slope, the severe gusts having as much as a 45° upward component where they pass through the anemometer. An area of approximately 17 square feet of the overhanging eaves at the northeast corner of the house catches the full force of these extreme gusts, and this portion gave way. Other adjacent portions of the roof followed, exposing the loft of the house, and it was necessary to chop a hole in the southwest portion of the roof to release the tremendous pressure head which at times caused the building to belly out under the strain. The observer estimated hurricane gusts of as high as 120 miles per hour during the period of maximum destruction.

Shingles from the roof were scattered over an area one-quarter mile wide, and one-half mile long. This whole area was carefully searched for parts of the missing wind instruments. The only part found was one of the anemometer cups, and it appeared to have been torn from the cup arm by sheer inertial force. The cup was found about one-third mile from the station. A furniture truck, loaded with kitchen stoves and other furniture, and another truck with a trailer, were blown over. On the following morning, two closed cars lost their tops; this quickly resulted when a window was opened toward the wind. The wind pressure inside the cars was sufficient to instantly blow off the tops. Such was the force produced by the wind that the tops were observed to be carried up into the air and over the edge of the cliff without even touching the ground. No doubt this type of damage would have been greater except for the highway patrolmen, who only allowed persons with heavy cars and urgent business to pass along the highway.

Another interesting feature of this period was the extreme dryness of the soil and all vegetation, revealed on the 23d, when a thorough search of the entire area to the south and west of the station was made in quest of the missing wind vane and anemometer. Dust was stirred up in the grass and leaves at each step, as the loose topsoil, previously frozen, had been dried by the persistent, penetrating easterly gales.

The airway beacons were behaving erratically on the evening of December 20, and many reports were received that the lights were out, or were functioning peculiarly. Several of the beacons were visible from Crown Point during the night. One of them was pointed at an odd angle into the sky, and was discovered next morning to have been blown off its base, and to be lying on the small platform atop the tower. Other revolving beacons were noticed to be flashing mostly down the gorge. The airway mechanician, who was in the gorge during the night, said that the lights would turn partly into the wind, and a gust would force the beacon backward, then another attempt into the wind would occur, and the beacon would again be pushed back by the force of the wind. These revolving beacons are turned by a clutch, and the clutch was not powerful enough to turn the beacons against the extreme gusts. From the lower end of the gorge the beacons were visible most of the time as the wind kept them straightened out in nearly one direction.

The average velocity of 38.2 miles per hour at Crown Point, for the period included in this study, is the highest of record for such periods since the station was established in 1929. The highest average velocity for a previous period of easterly winds was 35 miles per hour for 10 days in December 1934. Easterly gales also occur in connection with the movements of cyclones and anticyclones, but they are usually of shorter duration, and the average velocities are somewhat less.

All barometric data from standard mercurial barometers, reduced to sea level.

Distances (air-line): Portland–Crown Point, 24 miles.
Portland–Cascade locks, 45 miles.
Portland–Hood River, 59 miles.

Elevations: Barometers above sea level: Portland, 39 feet.
Hood River, 393 feet.

Anemometer above ground: Crown Point, 24 feet.
Cascade locks, 55 feet.

Anemometer above river (sea level): Crown Point, 761 feet.
Cascade locks, 250 feet.

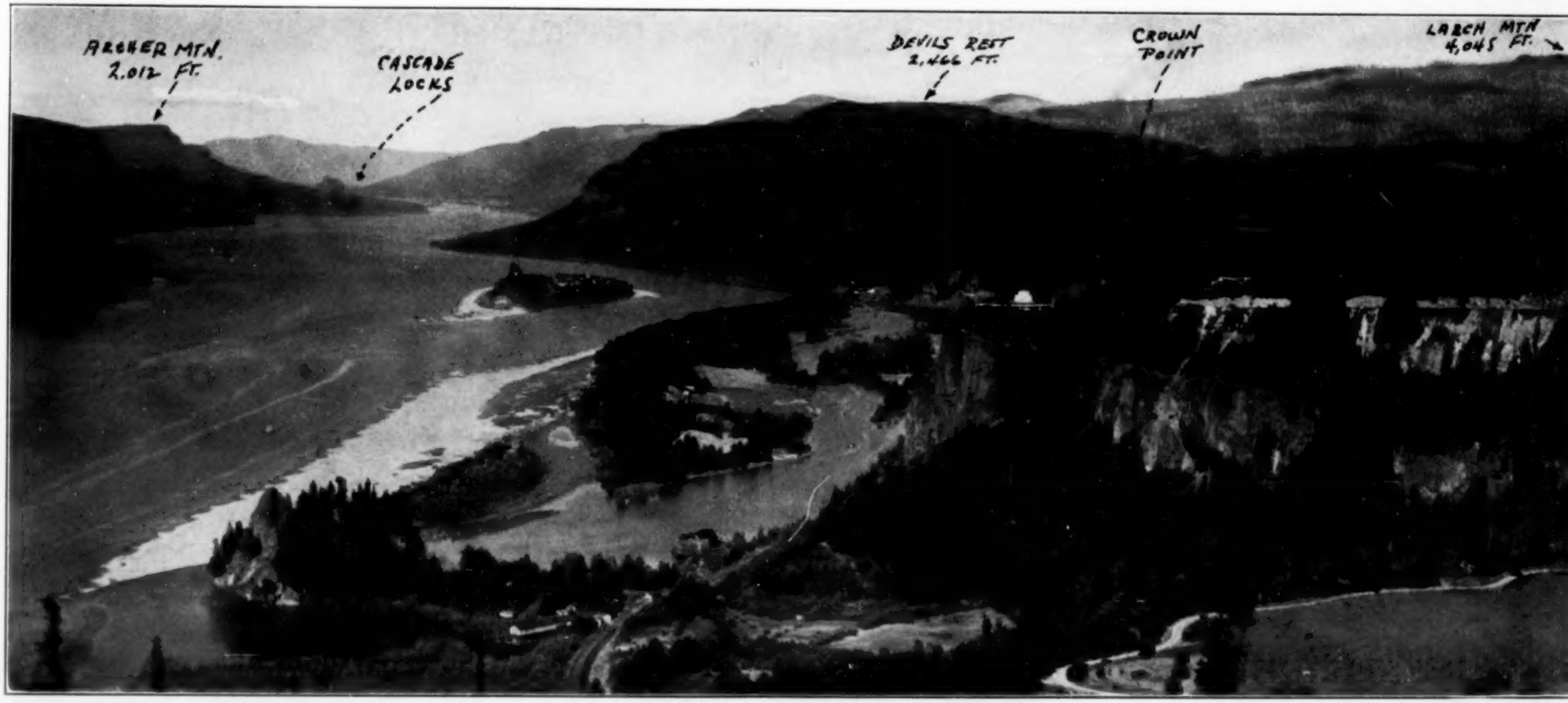

FIGURE 2.—Airplane view of Columbia River gorge, looking east-northeastward.

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TROPICAL DISTURBANCES, AUGUST 1936

By Willis E. Hurd

[Weather Bureau, Washington, September 1936]

Five tropical disturbances of the West Indian type occurred in the North Atlantic Ocean during August 1936. The earliest, that of the 9th–12th, which was of very slight intensity, was confined to the western Gulf of Mexico. The second, that of the 15th–19th, crossed the southern half of the Gulf, and locally developed some intensity during its westward passage. The third, that of the 20th–22d, originated east of the Bahamas, crossed northern Florida and thence, skirting the extreme northeastern Gulf coast, was of slight to moderate force only. The fourth disturbance, that of the 28th–30th, crossed the extreme lower portion of the Gulf, and was locally of considerable force on the 30th. Coincident with the final Gulf depression, reports were received on the 28th of a disturbance forming near 15° N., 45° W. This disturbance moved northwestward with rapid development. On the 31st, near 24° N., 56° W., winds of near hurricane force occurred. The storm thereafter moved into higher latitudes and on September 6–7 crossed the British Isles. A full description of this storm will appear in the September issue of the Review.

Two tropical cyclones occurred off the west coast of Mexico this month. They are described on pp. 277–278.

The approximate tracks and positions of the centers of four disturbances are given in figure 1.

Disturbance of August 9–12.—The first definite signs of development of a cyclonic circulation, with light winds, appeared in the 7 p. m. ship reports of August 8 about 200 miles west-southwest of Port Eads. During the 9th the winds became somewhat more vigorous with forces of 4–5 (Beaufort scale), except that in one instance a moderate gale (force 7) from east occurred. This was radioed to the forecast centers by the S. S. *E. R. Kemp* (barometer 29.90) in 28.8° N., 92.1° W., and was the highest velocity reported during the life of the depression.

At 7 p. m. (e. s. t.) of the 9th the center of the disturbance was located near 28° N., 92° W., moving slowly in a westerly direction, accompanied by moderate to fresh winds. The center, with little apparent depression of the barometer, continued to move westward until the morning observation of the 10th, at which time it was located near 27½° N., 94° W. Thereafter, the course of the depression was south-southwest to southwest, unaccompanied by winds of known gale force, until, on the 12th, it entered the Mexican coast north of Tampico.

Beginning late on the 9th, and continuing until afternoon of the 12th, all interests were advised of the progress of the disturbance by advisories or bulletins issued at 6-hour intervals from the forecast center at New Orleans. Orders to hoist small craft warnings from Galveston to Corpus Christi were issued on August 10 at 3 a. m. (e. s. t.).

Disturbance of August 15–19.—This disturbance appears to have originated over the extreme northwestern part of the Caribbean Sea on the 14th, but available reports during the day showed only gentle winds and little depression of the barometer. On the 15th the disturbed condition had moved northwestward, and at 6 p. m. local time was centered in approximately 23° N., 88° W. A report received subsequently by mail showed that at this time the S. S. *Cauto*, Tampico to Baltimore, 23°40′ N., 88°35′ W., experienced a north wind, force 5, barometer 29.73; at 6.50 p. m. (local time) the wind, of same force, had hauled to east, pressure 29.56. At 8 p. m., with rising barometer, the ship reported a southeast gale, force 9, thereafter diminishing.

The northwestward movement of the disturbance continued until the morning of the 16th with no increase in intensity so far as reports indicate. The highest wind during the day, according to mail reports, was of force 8, ESE., during squalls experienced by the S. S. *San Benito*

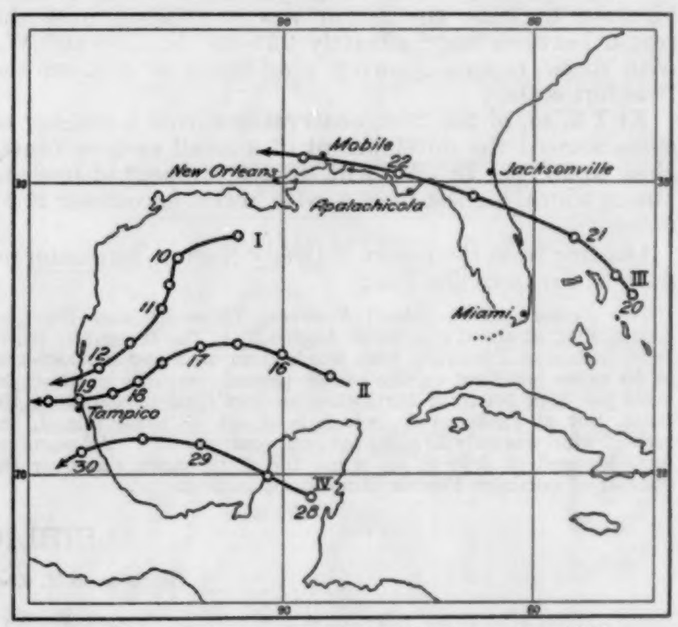

Figure 1.—Approximate tracks of tropical disturbances, August 1936.

between 4 and 7 a. m. (local time) near 24½° N., 90° W., lowest barometer 29.83.

The cyclone center, moving westward, was in approximately 24° N., 93° W., at 7 a. m. of the 17th, with winds of force 4–5 reported by ships at a considerable distance from the center. During the day the disturbance changed its course to southwesterly and at 7 p. m. (e. s. t.) was centered near 23½° N., 95° W. At this time the highest wind reported in connection with the disturbance was force 6, south, observed on the S. S. *Agwistar*, near 23° N., 94½° W.

The center continued to move southwestward until 7 a. m. of the 18th, at which time it was near 23° N., 96° W., and so far as reports indicate had meanwhile gathered energy. At this time the S. S. *San Ambrosia*, near

23° N., 95° W., had a south-southeast wind of force 8, attended by rain squalls of hurricane force, barometer 29.73; while the S. S. *Agwistar*, near 22½° N., 96½° W., had a west wind of force 7, barometer 29.62.

Thereafter the center moved toward west-southwest, then west, and passed inland a short distance north of Tampico on the morning of the 19th, accompanied by heavy rains. Quoting from the report of W. R. Stevens, forecaster on duty at New Orleans:

It is likely that the disturbance did not reach hurricane intensity although gusts and squalls of hurricane force probably occurred near the center. The highest velocity reported at Tampico was southwest 30 m. p. h. at 9 and 10 a. m., with lowest pressure 29.52 inches at 9 a. m. August 19.

From the morning of the 17th until the morning of the 19th, when the depression passed inland, frequent advisory messages and bulletins from the forecast center at New Orleans apprised all marine and other interests of the movements of the disturbance. On the morning of the 17th northeast storm warnings were ordered up from Brownsville to Corpus Christi, Tex., and southeast storm warnings northward from Corpus Christi to Matagorda.

Disturbance of August 20–22.—On the morning of August 20, slightly falling pressure, with cyclonic circulation, over and northeast of the northern Bahama Islands was evident on the weather map. By 7 p. m. (e. s. t.), although no low center could yet be located, a more vigorous cyclonic circulation was established over the region between approximately 25°–30° N., 75°–80° W., with ships' reports showing wind-forces of 4–6, on the Beaufort scale.

At 7 a. m. of the 21st, observations from a number of ships showed the development of a small cyclone center close to 28° N., 78° W., with accompaniment of fresh to strong winds, highest force 6, with lowest barometer 29.71 inches.

Quoting from the report of Grady Norton, forecaster on duty at Jacksonville, Fla.:

The center passed inland between Titusville and Daytona Beach, Fla., at about 5 p. m. of August 21. The barometer fell to 29.60 inches at Titusville, with winds from west and southwest 40 to 55 miles per hour as the center passed. Squalls of about 30 miles per hour occurred northward beyond Jacksonville along the coast, but at Jacksonville, which is about 18 miles inland, the highest wind was only 25 miles per hour (extreme 27). All warnings were lowered at 8:30 p. m. when the disturbance was over the interior of northern Florida diminishing in intensity.

No appreciable damage was caused by the storm according to early reports, and no loss of life occurred. The copious rains attending the disturbance were very beneficial to citrus and other late crops, and winds were not strong enough to cause any injury to fruit after reaching inland to the citrus regions.

The remnants of the disturbance persisted and crossed the northern part of the State and were in the vicinity of Apalachicola at 8 a. m. of August 22, but no strong winds occurred on the west coast of this district.

Frequent and ample advisory messages and cautionary warnings to small craft in connection with this disturbance were issued from the Jacksonville forecast center. Northeast storm warnings at 9:30 a. m. (e. s. t.) of the 21st were ordered hoisted from Fort Pierce, Fla., to Charleston, S. C.

Disturbance of August 28–30.—At the morning observation of August 28, conditions over the Yucatan Peninsula pointed toward the formation of a slight depression, with lowest barometer, 29.74, at Payo Obispo. At 7 p. m. of that date the suspicion was strengthened that a tropical disturbance was originating in the vicinity. Pressure at Merida had fallen to 29.68 inches, which indicated a northwestward movement of the depression.

On the morning of the 29th, reports from ship and Mexican coast stations indicated the formation of a circulatory wind system with center in the Gulf of Campeche. The S. S. *Ceiba*, near 20° N., 92° W., at 7 a. m. reported the lowest barometer, 29.70, with south wind of force 6. At 7 p. m. (e. s. t.) of the 29th four ships in the southwestern Gulf, within the region 20°–23° N., 92°–95° W., clearly showed the existence of a moderate depression with center a little north of the 20th parallel and close to the 95th meridian. Three of the ships, at some distance from the center reported wind forces of 5–6, while the S. S. *Amapala* in 19.8° N., 94.8° W., had a moderate west gale (force 7), pressure 29.53 inches. The extreme wind reported by the *Amapala* was of force 8, south, at 8 p. m., local time, of the 29th. During the morning of the 30th the disturbance became locally of much increased energy, as indicated by a report received by mail from the S. S. *Cayo Mambi*. This ship, in 21°40′ N., 97°00′ W., had a barometer reading of 29.52 inches, accompanied by a southeast gale of force 9. The maximum wind reported by the ship was from the east, force 11. The disturbance passed inland near Tuxpam on the morning of the 30th.

Advisories and cautionary warnings were issued from New Orleans during the 29th and on the morning of the 30th.

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[RICHMOND T. ZOCH, *in Charge of Library*]

By AMY D. PUTNAM

RECENT ADDITIONS

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The climate of Fort Huachuca, Cochise County, Ariz. 7 p. tables. 20½ cm. (Repr.: American medicine, v. 10, no. 13, pp. 516–518. Sept. 23, 1905.)

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Osservazioni meteorologiche della Somalia. Firenze. 1935–XIII. p. 91–101. tables. 24½ cm. (Extract from "Atti del Secondo Congresso di studi coloniali." Napoli. 1–5 Ottobre 1934–XII.)

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Report to the Congress on the unified development of the Tennessee river system. Submitted by the Board of directors of the Tennessee valley authority. March 1936. [Knoxville? Tenn. 1936.] 105 p. incl. illus., maps, tables, fold. diagr., profiles (1 fold.) 28 cm. On cover: The unified development of the Tennessee river system.

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SOLAR OBSERVATIONS

SOLAR RADIATION MEASUREMENTS DURING AUGUST 1936

By Irving F. Hand, *Assistant in Solar Radiation Investigations*

For a description of instruments employed and their exposures, the reader is referred to the January 1935 Review, page 24.

Table 1 shows that solar radiation intensities averaged below normal at all three Weather Bureau stations. Considerable haze, dust, and smoke were reported from both Madison and Lincoln.

Table 2 shows an excess in the amount of total solar and sky radiation received on a horizontal surface at all stations except Miami, Riverside, Blue Hill, and Ithaca.

The solar work at Pittsburgh was permanently discontinued during the month.

Polarization observations made at Washington on 4 days give a mean of 58 percent with a maximum of 61 percent on the 31st. At Madison, observations on 2 days give a mean of 44 percent with the higher value of 57 percent on the 24th. All of these values are below the corresponding August normals.

Table 1.—*Solar radiation intensities during August 1936*

[Gram-calories per minute per square centimeter of normal surface]

WASHINGTON, D. C.

Date	Sun's zenith distance										
	8 a. m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	75th mer. time	Air mass									Local mean solar time
		A. M.					P. M.				
	e	5.0	4.0	3.0	2.0	[1] 1.0	2.0	3.0	4.0	5.0	e
	mm.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mm.*
Aug. 1	19.23				1.20	1.35					16.20
Aug. 3	17.96			0.73	.96	1.27					17.37
Aug. 12	18.59				.66						17.96
Aug. 13	19.89			.50	.67						21.28
Aug. 17	19.23			.31	.44						16.20
Aug. 18	17.37		0.77	.92	1.07	1.29					15.65
Aug. 25	7.57			.81							7.29
Aug. 31	9.14	0.90	.96	1.07	1.24	1.46					6.76
Means		(.90)	(.86)	.72	.89	1.34					
Departures		+.27	+.17	−.05	−.05						

Table 1.—*Solar radiation intensities during August 1936*—Contd.

MADISON, WIS.

Date	Sun's zenith distance										
	8 a. m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	75th mer. time	Air mass									Local mean solar time
		A. M.					P. M.				
	e	5.0	4.0	3.0	2.0	[1] 1.0	2.0	3.0	4.0	5.0	e
	mm.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mm.*
Aug. 1	8.81	0.44	0.58	0.70	0.88	1.27					10.21
Aug. 3	14.10	.50	.63								14.60
Aug. 7	8.81		.42	.57	.78	1.22					9.14
Aug. 15	16.20					1.12					17.37
Aug. 24	15.65			.99	1.13	1.33					17.37
Means		(.47)	.54	.75	.93	1.24					
Departures		−.24	−.27	−.22	−.16						

LINCOLN, NEBR.

Date	8 a. m.	5.0	4.0	3.0	2.0	1.0	2.0	3.0	4.0	5.0	Noon
Aug. 5	12.68							0.54	0.42	0.31	9.14
Aug. 8	14.10		0.49	0.65	0.89	1.28					15.11
Aug. 12	11.81			.78	1.01	1.27	0.95	.72	.55	.46	15.11
Aug. 13	11.81						.98	.66	.53	.45	10.21
Aug. 14	15.65						.91	.73	.60	.50	17.37
Aug. 17	14.10	0.58	.69	.83	1.04	1.25	1.02	.85	.68	.58	11.38
Aug. 18	10.97	.71	.82	.97	1.15	1.31					11.81
Means		(.64)	.67	.81	1.02	1.28	1.07	.69	.75	.64	
Departures		−.04	−.11	−.10	−.07		−.11	−.19	−.19	−.18	

BLUE HILL OBSERVATORY OF HARVARD UNIVERSITY

Date	8 a. m.	5.0	4.0	3.0	2.0	1.0	2.0	3.0	4.0	5.0	Noon
Aug. 1	10.7				1.08	1.23	1.05				10.3
Aug. 3	12.3				.84	.96					13.7
Aug. 5	10.3					1.20					9.2
Aug. 7	11.5					1.23					11.5
Aug. 8	9.9				.91	1.24					13.3
Aug. 9	12.3			0.96	1.08	1.28	1.08				12.3
Aug. 10	11.9				.84	1.21					13.2
Aug. 12	15.3					1.09	.61				13.2
Aug. 13	14.3					.99					13.7
Aug. 14	14.7					.75					14.3
Aug. 16	19.5				.56	.92					18.8
Aug. 18	9.9		0.64	.82	1.05	1.38	1.07				11.5
Aug. 19	13.7			.56	1.18						14.3
Aug. 20	18.2					1.14	.90				12.3
Aug. 24	17.5				1.19	1.33	1.12	0.90	0.73		12.8
Aug. 25	13.7		.59	.73	.93	1.24					13.7
Aug. 26	9.9				1.21	1.40	1.32	1.24			8.8
Aug. 27	9.9				1.10	1.40	1.32	1.22			8.6
Aug. 28	9.2			1.01	1.23	1.30					9.9
Aug. 30	11.9							.89	.78	0.66	15.8
Aug. 31	10.3					1.34	1.15				11.5
Means			(.62)	.82	.96	1.19	1.07	1.06	(.76)	(.66)	

[1] Extrapolated.

TABLE 2.—*Average daily totals of solar radiation (direct + diffuse) received on a horizontal surface*

Week beginning—	Washington	Madison	Lincoln	Chicago	New York	Fresno	Pittsburgh	Fairbanks	Twin Falls	La Jolla	Miami	New Orleans	Riverside	Blue Hill	Friday Harbor	Ithaca	San Juan
	Gram-calories per square centimeter																
1936	*cal.*	*cal.*	*cal*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
July 30	522	535	552	472	477	688	488	482	530	577	443	--------	570	505	656	540	552
Aug. 6	466	518	510	513	460	603	510	472	470	520	473	--------	482	506	617	461	546
Aug. 13	489	394	546	425	401	662	373	259	486	449	415	--------	523	491	534	403	485
Aug. 20	515	392	521	370	383	666	--------	156	559	607	452	--------	539	451	436	412	428
Aug. 27	363	337	508	301	337	629	--------	252	480	514	484	337	506	394	432	333	628
	Departures from weekly normals																
July 30	+50	+69	+37	+95	+53	+29	--------	+147	−11	--------	−53	--------	−23	−8	+85	+98	--------
Aug. 6	+25	+62	+14	+123	+85	−25	--------	+155	−76	--------	−43	--------	−47	+4	+71	+18	--------
Aug. 13	+53	−47	+56	+37	+38	+43	--------	−30	+1	--------	−50	--------	−15	−18	−5	−35	--------
Aug. 20	−98	−13	+37	−29	+55	+79	--------	−143	+31	--------	−40	--------	+26	+40	−69	−33	--------
Aug. 27	−55	−37	+65	−50	−14	+61	--------	+5	−2	--------	+10	−34	+12	−4	−9	−38	--------
	Accumulated departures on Sept. 2																
	+4,186	+3,346	+7,455	+10,997	+6,629	+4,284	--------	+2,724	−1,295	--------	−7,014	--------	−328	−1,274	+140	+319	--------

TABLE 3.—*Total, I_m, and screened, I_y, I_r, solar radiation intensity measurements, obtained during August 1936 and determinations of the atmospheric turbidity factor, β, and water-vapor content, w=depth in millimeters, if precipitated*

AMERICAN UNIVERSITY, WASHINGTON D. C.

Date and hour angle	Solar altitude	Air mass	I_m	I_y	I_r	$\beta_{I_{m-r}}$	$\beta_{I_{y-r}}$	β_{mean}	$\frac{I_{m-r}}{1.94}$	$\frac{I_{y-r}-I_m}{1.94}$	w	Air-mass type
									Percentage of solar constant			
Aug. 18	° ′	*m*	*gr. cal.*	*gr. cal.*	*gr. cal.*						*mm*	
0:50 a. m.	61 50	1.13	1.203	0.839	0.677	0.149	0.142	0.146	70.4	8.2	5.0	N_{pc}
0:46 a. m.	62 11	1.13	1.212	.839	.677	.149	.142	.146	70.4	7.8	4.7	
Aug. 31												
3:05 a. m.	38 57	1.59	1.307	.918	.727	.067	.039	.053	77.3	9.8	8.2	N_{pc}
3:00 a. m.	39 51	1.56	1.314	.920	.729	.068	.040	.054	77.4	9.7	8.0	

Atmospheric conditions during turbidity measurements

Aug. 18. Temperature 28° C., wind, SE 8; polarization, 56.4 percent; blueness of sky, 5; visibility, 30 miles.
Aug. 31. Temperature 24° C., wind, NW 16; polarization, 60.9 percent; blueness of sky, 6; visibility, 50 miles.

BLUE HILL OBSERVATORY OF HARVARD UNIVERSITY

Date and hour angle	Solar altitude	Air mass	I_m	I_y	I_r	$\beta_{I_{m-r}}$	$\beta_{I_{y-r}}$	β_{mean}	$\frac{I_{m-r}}{1.94}$	$\frac{I_{y-r}-I_m}{1.94}$	w	Air-mass type
Aug. 1												
3:44 a. m.	36 57	1.66	1.127	0.720	0.583	0.080	0.102	0.091	70.2	10.4	9.6	N_{pc}.
0:38 p. m.	64 26	1.11	1.216	.783	.633	.162	.105	.134	73.0	8.2	7.9	
3:37 p. m.	38 24	1.61	1.112	.704	.578	.086	.145	.116	71.8	12.8	10.2	
Aug. 3												
2:56 a. m.	44 28	1.43	.915	.637	.531	--------	.125	.125	68.6	20.0	14.2	N_{pc}
Aug. 5												
2:53 a. m.	45 22	1.40	1.007	.666	.566	.150	--------	.150	65.6	12.7	10.9	N_{pc}, T_m
2:06 a. m.	53 05	1.25	1.176	.766	.623	.133	--------	.133	71.0	8.6	7.8	
0:16 a. m.	64 28	1.11	1.143	.742	.606	.140	.195	.168	68.2	7.3	7.0	
1:16 p. m.	50 57	1.15	1.181	.764	.613	.091	.158	.124	69.4	6.8	6.4	
Aug. 8												
4:17 a. m.	29 52	2.01	.904	.631	.536	.160	.118	.139	59.5	11.5	8.2	N_p
3:55 a. m.	33 41	1.80	.963	.667	.557	.155	.194	.174	58.9	7.8	5.9	
1:28 a. m.	60 32	1.14	1.153	.737	.612	.125	.225	.175	69.5	8.4	7.9	
Aug. 9												
4:26 a. m.	27 56	2.43	1.028	.739	.620	.120	.102	.111	61.4	7.0	4.5	N_p
0:26 a. m.	63 18	1.12	1.207	.813	.668	.137	.175	.156	68.1	4.2	4.0	
2:36 p. m.	47 27	1.35	1.218	.815	.674	.106	.102	.104	71.2	6.7	5.8	
Aug. 10												
4:07 a. m.	31 02	1.94	.861	.634	.541	--------	--------	--------	--------	--------	--------	--------
0:03 a. m.	63 14	1.12	1.157	.773	.633	.156	.129	.142	67.7	6.4	6.1	$N_p \rightarrow T_m$.
0:22 p. m.	62 12	1.12	1.138	.766	.629	.160	.188	.174	66.5	6.2	5.9	
Aug. 12												
1:46 p. m.	54 25	1.23	.975	.662	.551	.200	--------	--------	--------	--------	--------	$N_p \rightarrow T_m$
2:03 p. m.	51 49	1.27	.955	.646	.558	--------	--------	--------	--------	--------	--------	
2:29 p. m.	47 57	1.34	.880	.629	.541	--------	--------	--------	--------	--------	--------	
3:05 p. m.	41 52	1.49	.766	.562	.481	--------	--------	--------	--------	--------	--------	
3:30 p. m.	37 28	1.64	.714	.535	.462	--------	--------	--------	--------	--------	--------	

TABLE 3.—*Total, I_m, and screened, I_y, I_r, solar radiation intensity measurements, obtained during August 1936 and determinations of the atmospheric turbidity factor, β, and water-vapor content, w=depth in millimeters, if precipitated*—Continued

BLUE HILL OBSERVATORY OF HARVARD UNIVERSITY—Continued

Date and hour angle	Solar altitude	Air mass	I_m	I_y	I_r	$\beta_{I_{m-r}}$	$\beta_{I_{y-r}}$	β_{mean}	$\frac{I_{w=0}}{1.94}$	$\frac{I_{w=0}-I_m}{1.94}$	w	Air-mass type
									Percentage of solar constant			
	° ′	m	*gr. cal.*	*gr. cal.*	*gr. cal.*						*mm*	
Aug. 13												
2:09 a. m.	52 28	1.27	0.990	0.693	0.577	-----	-----	-----	-----	-----	-----	$N_P \rightarrow T_M$
0:13 a. m.	62 15	1.13	.977	.673	.561	-----	-----	-----	-----	-----	-----	
Aug. 14												
2:52 a. m.	43 59	1.44	.720	.529	.455	-----	-----	-----	-----	-----	-----	T_M
2:32 a. m.	47 10	1.37	.751	.556	.470	-----	-----	-----	-----	-----	-----	
0:34 p. m.	61 20	1.14	.727	.550	.461	-----	-----	-----	-----	-----	-----	
1:00 p. m.	39 26	1.16	.623	.461	.407	-----	-----	-----	-----	-----	-----	
3:35 p. m.	36 58	1.68	.395	.315	.295	-----	-----	-----	-----	-----	-----	
Aug. 16												
4:35 a. m.	25 05	2.35	.498	.367	.338	-----	-----	-----	-----	-----	-----	T_M
3:22 a. m.	38 14	1.61	.646	.464	.384	-----	-----	-----	-----	-----	-----	
Aug. 18												
5:22 a. m.	15 50	3.63	.695	.524	.467	0.134	0.177	0.156	39.5	3.3	-----	N_{PC}
4:10 a. m.	29 08	2.06	1.026	.707	.591	.100	.096	.098	63.6	10.1	7.1	
3:32 a. m.	36 00	1.70	1.140	.760	.629	.080	.148	.114	65.8	6.4	5.0	
1:27 a. m.	55 27	1.21	1.300	.840	.676	.057	.123	.090	75.2	7.4	6.7	
0:10 a. m.	60 57	1.14	1.326	.857	.682	.049	.100	.074	78.2	9.1	8.6	
0:15 p. m.	60 41	1.14	1.322	.851	.684	.053	.125	.089	77.8	8.9	8.3	
1:05 p. m.	51 48	1.18	1.307	.849	.673	.058	.096	.077	74.9	6.8	6.3	
3:52 p. m.	32 25	1.92	1.075	.726	.583	.069	.053	.061	72.1	16.1	11.8	
Aug. 19												
4:38 a. m.	23 44	2.48	.834	.583	.490	.115	.151	.133	53.8	10.3	6.6	N_{PC}
4:13 a. m.	25 21	2.33	.934	.645	.525	.085	.114	.100	56.0	7.3	4.8	
Aug. 20												
2:42 p. m.	44 08	1.46	1.020	.704	.576	.169	.178	.174	61.8	8.8	7.3	$N_P \rightarrow T_M$
3:15 p. m.	38 34	1.60	1.004	.688	.540	.115	.137	.126	67.2	14.2	11.2	
4:28 p. m.	25 30	2.32	.840	.600	.452	.090	.062	.076	65.3	21.2	14.0	
Aug. 24												
2:27 a. m.	45 32	1.40	1.303	.852	.679	.054	.075	.060	79.6	10.9	9.3	T_M
2:00 a. m.	49 28	1.31	1.323	.866	.689	.046	.082	.064	78.2	8.4	7.4	
0:10 a. m.	58 58	1.17	1.338	.867	.696	.063	.100	.082	78.1	7.5	7.0	$N_{PP} \rightarrow T_M$
2:02 p. m.	49 12	1.32	1.280	.829	.665	.059	.105	.082	76.8	8.7	7.6	
2:45 p. m.	42 37	1.48	1.225	.799	.652	.068	.106	.087	76.8	12.3	10.2	
3:02 p. m.	39 48	1.56	1.221	.794	.648	.067	.079	.073	74.4	10.1	8.2	
5:24 p. m.	14 10	4.02	.817	.597	.480	.050	.056	.053	58.3	15.2	6.0	
Aug. 25												
5:22 a. m.	14 19	3.99	.586	.444	.383	.068	.139	.104	47.2	6.3	3.2	$N_P \rightarrow T_M$
2:09 a. m.	47 55	1.34	1.133	.751	.617	.117	.158	.138	66.1	6.5	5.6	
1:54 a. m.	50 01	1.30	1.137	.762	.613	.117	.150	.134	69.4	9.6	8.5	
Aug. 26												
0:19 a. m.	58 04	1.18	1.367	.883	.714	.043	.107	.075	77.4	5.7	4.3	N_{PC}
0:54 p. m.	56 04	1.20	1.379	.900	.724	.049	.093	.071	76.6	4.0	4.7	
1:08 p. m.	55 04	1.22	1.379	.900	.722	.045	.085	.065	78.3	5.7	5.2	
2:49 p. m.	41 31	1.50	1.302	.858	.686	.042	.072	.057	77.8	9.2	7.6	
4:52 p. m.	19 39	2.96	1.049	.728	.590	.038	.057	.048	66.6	11.3	6.6	
Aug. 27												
3:04 a. m.	38 41	1.60	1.290	.857	.681	.035	.057	.046	77.9	9.5	7.5	N_{PC}
0:58 a. m.	55 44	1.21	1.375	.886	.707	.035	.081	.068	78.2	5.4	5.0	
0:36 a. m.	57 03	1.19	1.396	.901	.716	.032	.071	.052	80.6	7.1	5.6	
0:03 p. m.	58 00	1.18	1.383	.895	.705	.033	.060	.046	83.0	10.3	9.6	
4:50 p. m.	19 46	2.93	.989	.684	.552	.045	.064	.054	61.8	9.8	5.8	
Aug. 28												
4:52 a. m.	19 11	3.02	1.076	.763	.630	.044	.063	.054	64.6	8.0	4.7	N_{PC}
3:53 a. m.	29 56	2.00	1.231	.829	.671	.045	.069	.057	72.3	7.6	4.6	
3:02 a. m.	38 50	1.59	1.278	.848	.679	.045	.072	.058	75.4	8.2	5.9	
1:35 p. m.	51 39	1.27	1.296	.855	.686	.068	.098	.083	75.3	7.2	6.5	
1:56 p. m.	48 52	1.32	1.288	.855	.686	.050	.098	.074	76.6	8.9	7.8	
Aug. 30												
4:34 p. m.	21 48	2.68	.919	.637	.516	.062	.058	.060	65.9	17.6	10.1	N_{PC}
5:46 p. m.	10 02	5.58	.661	.500	.434	.075	.100	.088	45.4	11.2	4.8	
Aug. 31												
2:35 a. m.	51 43	1.29	1.107	.762	.614	.101	.151	.126	67.8	7.6	6.2	N_{PC}
2:17 p. m.	52 32	1.25	1.290	.864	.688	.091	.140	.116	72.4	4.7	4.2	

Atmospheric conditions during solar radiation measurements, Blue Hill Observatory of Harvard University, August 1936

Date	Time from apparent noon	Air temperature	Wind (Beaufort scale)	Visibility (0–10 scale)	Sky blueness	Cloudiness and remarks
		° C.				
1	3:39 a. m.	22.2	NW 1	8	8	3 Ci, mod. haze, thin Ci prob. on sun.
3	2:57 a. m.	27.7	S 2	7	7	Few Ci., few Acu, mod. haze.
5	2;35 a. m.	20.6	NE 3	6	4	3 Acu, dense haze, Ci near sun.
5	0:48 p. m.	21.1	NE 3	9	6	1 Ci, 2 Acu, light haze.
8	4:23 a. m.	18.6	WSW 2	7	7	Zero clouds, mod. haze.
9	3:29 a. m.	19.2	NNW 2	8	8	Few Ci, light haze.
9	0:12 a. m.	23.6	E 2	8	8	Few Ci, few Cu, light haze.
10	4:03 a. m.	19.2	SW 3	7	7	1 Ci, mod. haze.
10	0:06 a. m.	25.9	SW 4	8	5	1 Ci, mod. haze.
12	1:57 p. m.	23.3	E 3	7	5	2 Acu, mod. haze.
12	3:02 p. m.	23.4	NE 3	8	6	Few Acu, mod. haze.
13	2:03 a. m.	24.3	SW 3	6	6	Few Acu, dense haze.
13	0:19 a. m.	27.9	SW 3	6	5	1 Cu, dense haze.
14	2:48 a. m.	23.5	NE 2	6	6	1 Acu, dense haze.
14	0:41 p. m.	23.4	NNE 1	7	5	4 Ci, dense haze.
18	4:07 a. m.	15.0	NE 4	8	7	1 Acu, mod. haze.
18	0:02 a. m.	18.6	NE 2	9	8	Few Ci, 2 Cu, light haze.
19	4:34 a. m.	17.6	SSW 4	8	6	3 Ci, mod. haze.
20	2:56 p. m.	21.7	ENE 3	8	8	1 Ci, mod. haze.
24	2:17 a. m.	24.6	W 5	9	8	4 Cu, light haze.
24	2:47 p. m.	26.6	WNW 5 G.	9	8	Few Cu, light haze.
25	2:12 a. m.	22.8	W 3	8	8	2 Ci, 2 Cu, light haze.
26	0:30 p. m.	18.1	NW 3	9	8	3 Cu, light haze.
27	0:55 a. m.	18.0	NE 2	9	8	2 Ci, 2 Cu, light haze.
28	3:21 a. m.	16.4	N 2	8	8	1 Acu, few Cu, mod. haze.
28	1:38 p. m.	18.0	ENE 3	8	8	3 Stcu, mod. haze.
30	5:19 p. m.	21.9	W 4	7	7	Few Ci, few Cu, mod haze
31	2:27 a. m.	18.7	W 2	8	8	3 Ci, 3 Cu, mod. haze.

POSITIONS AND AREAS OF SUN SPOTS

[Communicated by Capt. J. F. Hellweg, U. S. Navy (Ret.), Superintendent U. S. Naval Observatory. Data furnished by the U. S. Naval Observatory in cooperation with Harvard and Mount Wilson Observatories. The difference in longitude is measured from the central meridian, positive west. The north latitude is positive. Areas are corrected for foreshortening and are expressed in millionths of the sun's visible hemisphere. The total area for each day includes spots and groups]

Date	Eastern standard time	Heliographic: D'ff. in longitude	Heliographic: Longitude	Heliographic: Latitude	Area: Spot	Area: Group	Total area for each day	Observatory
1936	h. m.	°	°	°				
Aug. 1	11 19	−25.0	56.8	−27.0		62		U. S. Naval.
		−15.0	66.8	−27.0		123		
		−14.5	67.3	−19.5		123		
		+14.0	95.8	+26.0		216	524	
Aug. 2	12 13	−10.0	58.0	−27.0		46		Do.
		−1.5	66.5	−27.0		123		
		−1.0	67.0	−19.0		123		
		+2.0	70.0	−22.0		31		
		+3.5	71.5	−18.0	8			
		+27.0	95.0	+26.0		185	516	
Aug. 3	11 2	+3.0	58.5	−27.0		31		Do.
		+10.5	66.0	−27.0		123		
		+11.0	66.5	−19.0		123		
		+16.0	71.5	−22.0		31		
		+17.0	72.5	−18.0		31		
		+21.0	76.5	−20.5	15			
		+38.0	93.5	+26.0		185	539	
Aug. 4	11 40	−80.0	321.9	+21.0	62			Do.
		−21.0	20.9	−26.5	15			
		+15.0	56.9	−27.0		31		
		+23.0	64.9	−27.0		123		
		+28.0	69.9	−19.0		340		
		+36.0	77.9	−20.5		31		
		+51.0	92.9	+26.0		154	756	
Aug. 5	11 15	−68.0	320.9	+21.0		123		Do.
		+26.0	54.9	−27.0	8			
		+32.0	60.9	+12.5		46		
		+37.0	65.9	−27.0		123		
		+42.0	70.9	−19.0		432		
		+65.0	93.9	+26.0		123	855	
Aug. 6	12 0	−73.0	302.2	−18.0	21			Mount Wilson.
		−65.0	310.2	+22.0		14		
		−64.0	311.2	−31.0		26		
		−52.0	323.2	+21.0	235			
		+40.0	55.2	−27.0	3			
		+47.0	62.2	+13.0		26		
		+51.0	66.2	−26.0	123			
		+58.0	73.2	−18.0		327		
		+64.0	79.2	−19.0		66		
		+80.0	95.2	+27.0	122		963	
Aug. 7	12 8	−60.0	302.0	−16.0	15			U. S. Naval.
		−54.0	308.0	−32.0		93		
		−53.0	309.0	+23.0		46		
		−39.5	322.5	+20.5		123		
		+58.0	60.0	+12.5		31		

POSITIONS AND AREAS OF SUN SPOTS—Continued

Date	Eastern standard time	Heliographic: Diff. in longitude	Heliographic: Longitude	Heliographic: Latitude	Area: Spot	Area: Group	Total area for each day	Observatory
1936	h. m.	°	°	°				
Aug. 7		+63.0	65.0	−27.0	31			U. S. Naval.
		+70.0	72.0	−19.0		185	524	
Aug. 8	11 12	−48.0	301.3	−16.0	15			Do.
		−41.0	308.3	−32.0		247		
		−40.0	309.3	+23.0		93		
		−28.0	321.3	+25.0	15			
		−26.0	323.3	+20.5		123	493	
Aug. 9	11 4	−75.0	261.1	+19.0		46		Do.
		−55.0	281.1	−15.0		77		
		−34.0	302.1	−16.0	8			
		−28.0	308.1	−32.0		401		
		−13.0	323.1	+20.5		123		
		+55.0	31.1	+16.5	15		670	
Aug. 10	11 17	−62.0	260.8	+19.0		93		Do.
		−41.0	281.8	−15.0		77		
		−15.0	307.8	−32.0		370		
		0.0	322.8	+21.0		123		
		+41.5	4.3	+12.5		93		
		+68.0	30.8	+17.0	15		771	
Aug. 11	13 15	−77.0	231.5	+22.0		28		Mount Wilson.
		−48.0	260.5	+19.0		138		
		−32.0	276.5	+13.0	5			
		−26.0	282.5	−15.0		105		
		−22.0	286.5	+24.0	5			
		−3.0	305.5	−32.0		410		
		+15.0	323.5	+22.0		101		
		+58.0	6.5	+13.0		52		
		+80.0	28.5	+17.0	20		864	
Aug. 12	11 10	−66.0	230.4	+24.0	31			U. S. Naval.
		−34.0	262.4	+19.0		62		
		−18.0	278.4	−15.5	15			
		−11.0	285.4	−15.5	8			
		−11.0	285.4	+22.5		31		
		+3.0	299.4	−35.0		154		
		+16.0	312.4	−30.0	15			
		+26.0	322.4	+20.5	46			
		+71.0	7.4	+11.0		31	393	
Aug. 13	11 38	−60.5	222.4	+23.0	15			Do.
		−52.5	230.4	+23.0	31			
		−20.5	262.4	+19.0		216		
		−3.5	279.4	−15.0	15			
		+17.0	299.9	−35.0		123		
		+40.0	322.9	+20.5	15		415	
Aug. 14	11 2	−87.0	183.0	+30.5	93			Do.
		−47.0	223.0	+22.5		93		
		−39.5	230.5	+22.5	31			
		−7.0	263.0	+19.0		247		
		+10.0	280.0	+14.0		46		
		+30.0	300.0	−35.0		154		
		+52.0	322.0	+20.5		46	710	
Aug. 15	11 30	−72.0	184.5	+31.0		230		Mount Wilson
		−50.0	206.5	+21.0		127		
		−30.0	226.5	+24.0		75		
		+5.0	261.5	−18.0	2			
		+7.0	263.5	+20.0		121		
		+25.0	281.5	+15.0		6		
		+30.0	286.5	+25.0	2			
		+43.0	299.5	−33.0	179			
		+68.0	324.5	+21.0		8	750	
Aug. 16	12 45	−65.0	177.6	+31.0		409		Do.
		−36.0	206.6	+22.0		143		
		−32.0	210.6	−18.0		18		
		−15.0	227.6	+24.0		54		
		+19.0	261.6	+21.0		138		
		+58.0	300.6	−32.0		35	797	
Aug. 17	10 56	−67.0	163.4	+29.0	123			U. S. Naval.
		−50.0	180.4	+30.0		247		
		−24.0	206.4	+20.0		123		
		−20.0	210.4	−18.0		62		
		+29.0	259.4	+20.0		123		
		+50.0	280.4	+14.0	31		709	
Aug. 18	11 25	−53.0	164.0	+29.0	62			Do.
		−37.0	180.0	+30.0		247		
		−10.5	206.5	+20.0		154		
		−7.0	210.0	−18.0		46		
		+41.0	258.0	+19.5		62		
		+63.0	280.0	+14.0		77	648	
Aug. 19	13 5	−49.0	153.9	+20.0		6		Mount Wilson.
		−28.0	174.9	+30.0		534		
		+6.0	208.9	+22.0		190		
		+9.0	211.9	−18.0		2		
		+53.0	255.9	+20.5	10			
		+75.0	277.9	+14.0		85	827	
Aug. 20	11 51	−29.0	161.3	+28.5	46			U. S. Naval.
		−11.0	179.3	+30.0		216		
		+18.0	208.3	+21.0		185	447	
Aug. 21	11 13	−16.0	161.4	+28.5	46			Do.
		+1.0	178.4	+30.0		185		
		+30.0	207.4	+21.0		185	416	
Aug. 22	11 10	−78.0	86.2	+27.0	46			Do.
		−57.0	107.2	−10.5		93		
		−4.0	160.2	+28.0		46		
		+13.0	177.2	+30.0		185		
		+43.0	207.2	+21.0		154	524	
Aug. 23	12 6	−76.0	74.5	−22.0	62			Do.
		−64.0	86.5	+27.0	31			
		−44.0	106.5	−10.0		62		
		+9.0	159.5	+28.5		62		
		+27.0	177.5	+30.5		154		
		+59.0	209.5	+20.5		123	494	

POSITIONS AND AREAS OF SUN SPOTS—Continued

Date	Eastern standard time	Heliographic: Diff. in longitude	Heliographic: Longitude	Heliographic: Latitude	Area: Spot	Area: Group	Total area for each day	Observatory
1936	h. m.	°	°	°				
Aug. 24	11 34	−70.0	67.6	−23.0	15			U. S. Naval.
		−62.0	75.6	−22.0	62			
		−59.0	78.6	+30.0		62		
		−51.0	86.6	+27.0	46			
		−29.0	108.6	−10.0		62		
		+21.0	158.6	+29.0		46		
		+39.5	177.1	+30.5		77		
		+70.0	207.6	+20.0		31	401	
Aug. 25	11 27	−68.0	56.4	−27.0		216		Do.
		−49.0	75.4	−23.0	77			
		−39.0	85.4	+27.0	31			
		−11.0	113.4	−10.0	31			
		+34.0	158.4	+29.0		31		
		+50.5	174.9	+30.5	93			
		+78.0	202.4	+14.0		31	510	
Aug. 26	14 37	−53.0	56.5	−27.0		216		Do.
		−33.0	76.5	−23.0	93			
		−25.0	84.5	+27.0	31			
		−5.0	104.5	−17.0		123		
		+3.0	112.5	−9.0	31			
		+49.0	158.5	+29.5		46		
		+65.0	174.5	+30.0	62		602	
Aug. 27	11 10	−62.0	36.1	+17.0		7		Mount Wilson.
		−40.0	58.1	−28.0		438		
		−22.0	76.1	−21.0	134			
		−13.0	85.1	+28.0		48		
		+7.0	105.1	−17.0		213		
		+11.0	109.1	−11.0		2		
		+16.0	114.1	−8.0		77		
		+75.0	173.1	+32.0		87	1,006	
Aug. 28	12 35	−47.0	37.2	+15.0		8		Do.
		−25.0	59.2	−27.0		715		
		−7.0	77.2	−23.0	107			
		−2.0	82.2	+27.0		17		
		+6.0	90.2	−10.0		6		
		+23.0	107.2	−16.0		191		
		+27.0	111.2	−11.0		2		
		+30.0	114.2	−7.0	30		1,076	
Aug. 29	12 45	−37.0	33.9	+18.0		106		Do.
		−15.0	55.9	−27.0		1,036		
		+5.0	75.9	−22.0		88		
		+12.0	82.9	+28.0		18		
		+20.0	90.9	−11.0		10		
		+37.0	107.9	−17.0		144		
		+44.0	114.9	−8.0	28			
		+50.0	120.9	−22.0	10		1,440	
Aug. 30	12 7	−23.0	35.0	+18.0		31		U. S. Naval.
		−3.0	55.0	−27.0		679		
		+18.0	76.0	−22.0	15			
		+26.0	84.0	+27.0		46		
		+34.0	92.0	−10.5		93		
		+50.0	108.0	−17.0	31			
		+53.0	111.0	−10.0		31	926	
Aug. 31	11 26	−71.0	334.2	+14.0	15			Do.
		−9.0	36.2	+18.0		31		
		+10.0	55.2	−27.0		617		
		+30.5	75.7	−33.0	31			
		+47.0	92.2	−12.0		123		
		+61.0	106.2	−17.5	15			
		+66.0	111.2	−10.0		15	847	

Mean daily area for 31 days, 691.

PROVISIONAL SUN-SPOT RELATIVE NUMBERS, JULY 1936

[Data dependent alone on observations at Zurich and its station at Arosa]

[Furnished through the courtesy of Prof. W. Brunner, Eidgen. Sternwarte, Zurich, Switzerland]

July 1936	Relative numbers	July 1936	Relative numbers	July 1936	Relative numbers
1	*MEcc* 79	11	*Ec* 49	21	28
2	74	12	67	22	*a* 27
3	44	13	67	23	*Mc* 30
4	50	14	*b* 76	24	36
5	*Mac* 52	15	67	25	42
6	37	16	*d* 69	26	49
7	30	17	67	27	38
8	*d* 47	18	53	28	*d* --
9	43	19	49	29	*WEcc* 59
10	47	20	43	30	61
				31	*b* 93

Mean, 30 days=52.4.

a=Passage of an average-sized group through the central meridian.
b=Passage of a large group or spot through the central meridian.
c=New formation of a center of activity: E, on the eastern part of the sun's disk; W, on the western part; M, in the center circle zone.
d=Entrance of a large or average-sized center of activity on the east limb.

PROVISIONAL SUN-SPOT RELATIVE NUMBERS, AUGUST 1936

[Data dependent alone on observations at Zurich and its station at Arosa]

[Furnished through the courtesy of Prof. W. Brunner, Eidgen. Sternwarte, Zurich, Switzerland]

August 1936	Relative numbers	August 1936	Relative numbers	August 1936	Relative numbers
1	64	11	*a* 83	21	*a* 71
2	*ab* 64	12	*a* 76	22	*Eac* 64
3	74	13	*Mc* 90	23	*ad* 64
4	*d* 65	14	103	24	*d* 63
5	*Mc* 87	15	*acd* 123	25	*Ec* 91
6	86	16	93	26	*a* 76
7	89	17	105	27	*a* 87
8	*Ec* 89	18	115	28	91
9	107	19	*a* 90	29	*Macd* 106
10	*Wac* 89	20	65	30	*b* 125
				31	120

Mean, 31 days=87.6.

a=Passage of an average-sized group through the central meridian.
b=Passage of a large group or spot through the central meridian.
c=New formation of a center of activity: E, on the eastern part of the sun's disk; W, on the western part; M, in the central circle zone.
d=Entrance of a large or average-sized center of activity on the east limb.

AEROLOGICAL OBSERVATIONS

[Aerological Division, D. M. LITTLE in charge]

By L. T. SAMUELS

Attention is invited to the note at the foot of table 1, regarding the data on which the normals are based.

The super-normal surface temperatures for August over the central portion of the country, shown on chart I of this REVIEW, extended to considerable heights (see table 1). The largest free-air temperature departures occurred over Omaha at the 1,500- and 2,000-meter levels. Above these levels the departures decreased generally with altitude, in some cases becoming negative at the more southern stations.

The free-air relative humidity departures were mostly of opposite sign to those of temperature, with the largest negative departures occurring over Omaha at the 2,000-meter level. At 5,000 meters, however, the region of maximum negative relative humidity departures was displaced to the southeastern portion of the country. From chart V (inset) in this REVIEW it is seen that the monthly precipitation was deficient over the same general region where the greatest negative free-air relative humidity departures occurred.

Although the period of record at El Paso is only 2 years, it is evident that the average relative humidity during the warm season increases appreciably with elevation and results in higher mean relative humidity at 4,000 meters than at any other station. The relation of this condition to the general circulation and upper air pressure distribution over the United States and adjacent regions presents an interesting problem for investigation.

The resultant free-air wind direction for August was in most cases close to normal, with resultant velocities generally above normal. Principal exceptions occurred over the southeastern region where a pronounced easterly component prevailed at 3,000 and 4,000 meters as compared to the normal westerly component at those levels, and over the more eastern stations above 1,000 meters where the resultant velocities were below normal.

TABLE 1.—*Mean free-air temperatures and relative humidities obtained by airplanes during August 1936*

TEMPERATURE (° C.)

Stations	Altitude (meters) m. s. l.																			Number of observations
	Surface		500		1,000		1,500		2,000		2,500		3,000		4,000		5,000			
	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal		
Barksdale Field (Shreveport), La.[1] (52 m)	24.5		26.7		23.8		20.0		16.7		13.7		11.0		5.1		-1.5			31
Billings, Mont.[2] (1088 m)	17.8	+0.8					20.3	+0.8	18.3	+1.2	15.1	+1.4	11.5	+1.5	4.2	+1.9	-3.2	+2.2		31
Boston, Mass.[1] (5 m)	18.4		18.9		16.5		13.7		11.0		8.9		6.5		1.2		-4.1			26
Cheyenne, Wyo.[2] (1873 m)	14.8	+0.1							16.5	+0.3	17.7	+0.7	14.6	+0.3	6.7	+0.1	-0.9	+0.5		31
El Paso, Tex.[2] (1194 m)	22.6						23.9		21.6		18.0		14.1		6.4		-0.9			31
Fargo, N. Dak.[2] (274 m)	17.4	+1.7	20.4	+1.9	19.2	+1.5	16.5	+1.1	13.9	+1.3	11.3	+1.4	7.8	+1.1	1.4	+0.9	-5.5	+0.6		31
Kelly Field (San Antonio), Tex.[1] (206 m)	22.6	-0.8	24.1	+0.1	22.7	+0.2	19.9	-0.3	16.7	-0.5	14.1	-0.3	11.3	-0.3	5.1	-0.4	-1.8	-1.0		31
Lakehurst, N. J.[3] (39 m)	18.7		20.2		18.1		15.7		13.1		10.9		8.5		3.3		-1.7			23
Maxwell Field (Montgomery), Ala.[1] (52 m)	24.5	+0.2	25.2	+0.3	22.4	-0.1	19.0	-0.4	15.9	-0.6	13.2	-0.5	10.7	-0.2	4.8	-0.4	-0.9	-0.4		30
Miami, Fla.[2] (4 m)	25.1		24.4		21.3		18.3		15.8		13.3		10.5		5.0		-0.5			30
Mitchel Field (Hempstead, L. I.), N. Y.[1] (29 m)	19.5	+1.0	20.2	+0.6	18.7	+1.3	15.8	+1.3	12.9	+1.1	10.0	+0.9	7.5	+0.8	2.5	+1.3				26
Murfreesboro, Tenn.[2] (174 m)	22.6	+0.3	24.4	+0.7	22.5	+0.6	19.2	+0.5	15.5	-0.1	12.3	-0.1	9.7	+0.1	3.9	+0.4	-1.8	+0.7		31
Norfolk, Va.[3] (10 m)	23.2	-0.7	23.3	+0.3	20.5	-0.2	17.7	0.0	14.9	+0.2	11.7	-0.3	8.5	-0.9	2.4	-1.8	-2.8	-1.7		18
Oklahoma City, Okla.[2] (391 m)	25.5	+0.6	27.7	+1.3	27.4	+1.3	23.6	+0.8	19.8	+0.5	16.2	+0.2	12.6	0.0	5.4	-0.4	-1.7	-1.0		31
Omaha, Nebr.[2] (300 m)	22.3	+2.5	24.8	+3.3	25.7	+3.4	23.8	+3.7	20.9	+3.7	17.3	+3.2	13.8	+3.0	6.6	+2.6	-1.3	+1.4		31
Pearl Harbor, Territory of Hawaii[3] (6 m)	24.0	-1.8	21.6	-0.5	17.8	-0.4	15.0	-0.4	13.0	-0.3	11.8	+0.5	9.4	+0.4	3.3	-0.7				31
Pensacola, Fla.[3] (13 m)	23.6	-1.4	23.7	+0.1	20.6	-0.2	17.6	-0.1	14.8	+0.1	12.1	+0.2	9.4	+0.4	3.9	+0.7	-1.5	+0.6		31
Salt Lake City, Utah[2] (1288 m)	19.1						22.4		21.0		17.2		12.9		3.9		-4.4			31
San Diego, Calif.[3] (10 m)	20.7	-0.1	18.1	-0.9	23.7	+0.7	23.5	+1.2	20.3	+0.1	16.8	0.0	13.1	-0.3	5.8	-0.7	-0.8	-0.8		31
Sault Ste. Marie, Mich.[2] (217 m)	13.7		14.9		13.1		10.7		8.7		6.4		3.7		-2.3		-8.3			30
Scott Field (Belleville), Ill.[1] (135 m)	22.5	+1.6	26.0	+1.5	24.1	+1.2	20.7	+0.7	17.4	+0.4	14.3	+0.5	11.3	+0.6	5.0	+0.9	-1.7	+0.5		29
Seattle, Wash.[2] (10 m)	13.4	-4.2	15.8	+0.1	14.7	+0.1	11.6	-0.8	8.9	-1.2	5.5	-2.3	3.4	-2.1	-2.6	-2.6	-9.2	-3.1		7
Selfridge Field (Mount Clemens), Mich.[1] (177 m)	17.7	+0.2	20.2	+0.5	19.0	+1.2	16.5	+1.3	13.5	+1.1	10.1	+0.5	7.0	+0.2	0.3	-0.7	-6.6	-1.3		31
Spokane, Wash.[2] (596 m)	14.8	+0.2			20.3	+0.5	19.5	+1.4	15.5	+1.4	11.3	+1.3	7.7	+1.3	0.9	+0.8	-6.4	+0.4		31
Washington, D. C.[3] (13 m)	21.6	-0.7	21.7	+0.3	20.0	+0.6	17.2	+0.6	13.9	+0.2	11.1	+0.2	8.0	-0.1	2.8	-0.1	-2.8	-0.1		30
Wright Field (Dayton), Ohio[1] (244 m)	20.9	+1.5	22.6	+1.3	22.6	+2.1	19.5	+1.9	16.3	+1.4	13.1	+1.1	10.4	+1.0	4.9	+1.2	-1.0	+1.1		31

RELATIVE HUMIDITY (PERCENT)

Stations	Surface Mean	Surface Dep.	500 Mean	500 Dep.	1,000 Mean	1,000 Dep.	1,500 Mean	1,500 Dep.	2,000 Mean	2,000 Dep.	2,500 Mean	2,500 Dep.	3,000 Mean	3,000 Dep.	4,000 Mean	4,000 Dep.	5,000 Mean	5,000 Dep.	Number of observations
Barksdale Field (Shreveport), La.	80		62		62		66		70		63		58		51		58		
Billings, Mont.	55	+4					45	+4	44	+4	47	+5	52	+6	58	+7	59	+5	
Boston, Mass.	81		61		60		65		61		51		55		54		46		
Cheyenne, Wyo.	66	+1							58	-2	45	-4	44	-3	50	0	56	-1	
El Paso, Tex.	57						53		54		58		64		72		69		
Fargo, N. Dak.	69	-8	56	-5	52	-3	52	-2	52	-1	48	-2	51	+1	48	+1	46	+2	
Kelly Field (San Antonio), Tex.	90	0	87	0	73	+2	69	+6	68	+5	61	+3	56	+2	53	+2	54	+3	
Lakehurst, N. J.	90		63		58		55		57		54		53		56		54		
Maxwell Field (Montgomery), Ala.	88	-1	67	-5	69	-2	70	-1	65	-3	59	-6	53	-10	51	-7	41	-9	
Miami, Fla.	89		83		79		76		66		56		55		51		42		
Mitchel Field (Hempstead, L. I.), N. Y.	91	0	80	+7	70	+1	71	+1	70	+3	67	+6	60	+5	59	+8			
Murfreesboro, Tenn.	87	-1	66	-5	64	-5	66	-6	68	-1	60	-6	55	-6	53	-5	48	-2	
Norfolk, Va.	88	+7	69	-2	67	0	65	-1	61	-5	61	-3	61	+1	52	+3	47	+5	
Oklahoma City, Okla.	53	-10	49	-10	43	-10	44	-10	46	-7	46	-7	46	-7	47	-5	45	-6	
Omaha, Nebr.	70	-9	58	-10	47	-7	43	-9	41	-11	42	-9	42	-9	44	-6	52	+2	
Pearl Harbor, Territory of Hawaii.	79	+8	80	+3	84	0	80	+1	65	-2	44	-9	36	-8	23	-9	30	+1	
Pensacola, Fla.	92	+6	81	+2	79	+2	76	+2	71	0	67	-1	63	-2	56	-6	45	-9	
Salt Lake City, Utah.	57						44		40		40		43		52		57		
San Diego, Calif.	87	+6	91	+11	51	+3	38	0	39	+3	42	+4	47	+6	55	+10	51	+9	
Sault Ste. Marie, Mich.	89		72		71		72		65		59		56		61		59		
Scott Field (Belleville), Ill.	74	-10	55	-5	54	-5	56	-1	56	0	56	+2	50	+1	46	0	43	+1	
Seattle, Wash.	87	+13	73	0	62	-4	67	+4	64	+4	62	+9	58	+11	49	+12	46	+13	
Selfridge Field (Mount Clemens), Mich.	81	-2	63	-2	57	-4	52	-5	50	-3	50	-1	49	+1	47	+1	41	0	
Spokane, Wash.	58	0			45	+2	41	+1	43	+1	46	+1	48	+2	46	+3	45	+4	
Washington, D. C.	86	+8	62	-6	53	-11	56	-9	63	-3	56	-6	58	-1	48	-4	41	-7	
Wright Field (Dayton), Ohio.	81	-4	74	+1	70	+2	73	+3	74	+9	74	+11	66	+8	60	+6	58	+9	

[1] Army. [2] Weather Bureau. [3] Navy.

Observations taken about 4:00 a. m., 75th meridian time, except along the Pacific coast and Hawaii where they are taken at dawn.

NOTE.—The departures are based on normals covering the following total number of observations made during the same month in previous years, including the current month. The figures in parenthesis indicate the number of years of record: Billings, 92 (3); Cheyenne, 93 (3); Fargo, 93 (3); Kelly Field, 93 (3); Maxwell Field, 90 (3); Mitchell Field, 87 (3); Murfreesboro, 93 (3); Norfolk, 158 (8); Oklahoma City, 92 (3); Omaha, 177 (6); Pearl Harbor, temp. 162 (8), hum. 132 (7); Pensacola, 217 (9); San Diego, 203 (8); Scott Field, 88 (3); Seattle, 69 (7); Selfridge Field, 91 (3); Spokane, 93 (3); Washington, 242 (12); Wright Field, 93 (3).

LATE REPORT FOR JULY 1936

TEMPERATURE (° C)

Station	Surface Mean	Surface Dep.	500 Mean	500 Dep.	1,000 Mean	1,000 Dep.	1,500 Mean	1,500 Dep.	2,000 Mean	2,000 Dep.	2,500 Mean	2,500 Dep.	3,000 Mean	3,000 Dep.	4,000 Mean	4,000 Dep.	5,000 Mean	5,000 Dep.	Number of observations
Pearl Harbor, Territory of Hawaii[3] (6 m.)	23.8	-1.6	21.4	-1.0	17.7	-1.0	14.5	-1.5	12.2	-1.3	10.1	-1.7	8.2	-2.0	3.3	-2.2			31

RELATIVE HUMIDITY (PERCENT)

Station	Surface Mean	Surface Dep.	500 Mean	500 Dep.	1,000 Mean	1,000 Dep.	1,500 Mean	1,500 Dep.	2,000 Mean	2,000 Dep.	2,500 Mean	2,500 Dep.	3,000 Mean	3,000 Dep.	4,000 Mean	4,000 Dep.	5,000 Mean	5,000 Dep.	Number of observations
Pearl Harbor, Territory of Hawaii.	79	+8	80	+4	84	+2	82	+5	73	+2	57	+1	42	+1	24	-1			

NOTE.—The departures are based on normals covering the following total number of observations made during the same month in previous years, including the current month. Pearl Harbor, 111 (6).

Table 2.—*Free-air resultant winds (meters per second) based on pilot-balloon observations made near 5 a. m. (E. S. T.) during August 1936*

[Wind from N=360°, E=90°, etc.]

Altitude (m) m. s. l.	Albuquerque, N. Mex. (1,554 m)		Atlanta, Ga. (309 m)		Billings, Mont. (1,088 m)		Boston, Mass. (15 m)		Cheyenne, Wyo. (1,873 m)		Chicago, Ill. (192 m)		Cincinnati, Ohio (153 m)		Detroit, Mich. (204 m)		Fargo, N. Dak. (274 m)		Houston, Tex. (21 m)		Key West, Fla. (11 m)		Medford, Oreg. (410 m)		Murfreesboro, Tenn. (180 m)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
	°		°		°		°		°		°		°		°		°		°		°		°		°	
Surface	5	1.3	17	0.7	320	2.2	287	5.8	279	2.5	206	0.7	100	0.4	330	0.7	108	1.5	35	0.3	94	2.7	268	0.9	172	1.0
500			355	1.3			308	2.8			241	3.0	243	3.4	297	0.5	120	3.1	178	4.2	104	5.7	281	1.6	216	5.0
1,000			246	1.2			301	3.5			260	3.9	264	6.3	272	3.1	183	1.2	156	3.4	109	5.2	303	1.8	238	4.8
1,500			252	0.8	241	0.6	283	5.0			266	6.0	272	6.4	273	5.0	301	2.8	138	3.4	110	4.4	203	0.2	241	2.5
2,000	140	1.9	164	0.2	236	1.8	281	5.5	275	4.5	273	7.9	277	5.2	279	5.5	291	5.6	122	3.6	111	3.6	228	1.1	245	1.6
2,500	186	2.8	354	0.6	233	3.1	287	6.9	269	4.0	281	7.2	271	5.0	276	5.9	293	9.0	108	3.7	108	3.3	216	4.9	256	1.4
3,000	209	2.1	60	0.9	250	4.6	276	8.5	268	3.4	313	3.4	273	4.6	279	6.1	296	10.0	95	4.0	112	2.4	212	6.7	188	2.0
4,000	204	1.8	75	3.7	259	7.8	289	7.9	258	4.5	314	3.1			273	5.6			81	3.6	350	1.7	218	7.5		
5,000	134	2.2	52	3.2	264	10.1			256	6.1					283	6.4			107	3.9			226	9.5		

Altitude (m) m. s. l.	Newark, N. J. (14 m)		Oakland, Calif. (8 m)		Oklahoma City, Okla. (402 m)		Omaha, Nebr. (306 m)		Pearl Harbor, Territory of Hawaii [1] (68 m)		Pensacola, Fla.[1] (24 m)		St. Louis, Mo. (170 m)		Salt Lake City, Utah (1,294 m)		San Diego, Calif. (15 m)		Sault Ste. Marie, Mich. (198 m)		Seattle, Wash. (14 m)		Spokane, Wash. (603 m)		Washington, D. C. (10 m)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
	°		°		°		°		°		°		°		°		°		°		°		°		°	
Surface	283	0.8	318	1.1	182	3.9	135	1.1	58	4.5	59	1.3	204	1.7	140	3.7	12	1.1	57	0.3	125	1.0	97	1.6	255	0.5
500	298	4.6	234	2.4	196	8.4	162	4.2	72	7.9	108	1.5	214	6.2			343	0.6	200	0.7	45	1.7			272	3.9
1,000	296	4.7	302	3.4	210	12.9	199	7.5	76	8.1	146	2.1	241	6.2			94	1.0	258	3.7	352	1.5	217	2.5	288	4.3
1,500	283	4.5	280	2.7	208	7.2	227	7.8	85	6.7	122	2.5	251	5.5	153	5.9	157	2.5	267	5.4	328	2.0	225	3.0	288	5.0
2,000	274	4.7	236	3.1	201	3.4	247	7.5	106	3.8	94	2.5	264	4.7	172	5.5	148	3.5	278	6.9	287	1.6	222	3.8	288	5.6
2,500	271	6.0	217	3.3	203	1.4	262	6.7	111	2.7	87	2.5	269	4.6	197	4.6	140	5.5	288	8.3	245	2.5	228	4.6	285	6.0
3,000	271	8.2	221	4.4	155	1.4	279	6.7	127	1.8	89	3.9	284	5.0	221	4.4	140	5.9	286	8.0	239	3.0	238	6.3	285	4.7
4,000					138	2.7	298	6.9			81	4.7	289	2.7	232	5.5	159	6.3	286	8.3	259	3.5	231	6.4	296	5.1
5,000					174	2.7	302	7.4							232	5.8			288	10.9	256	4.9				

[1] Navy stations.

RIVERS AND FLOODS

[River and Flood Division, Montrose W. Hayes in charge]

By W. J. Moxom

Small, unimportant floods occurred during August in the Little, Neuse, and Cape Fear Rivers in North Carolina; in the Santee and Savannah Rivers in South Carolina; and in the lower Apalachicola and Choctawhatchee Rivers in western Florida. Losses in the Neuse River district amounted to approximately $5,000; elsewhere they were negligible.

On August 3 an excessive downpour in the mountains above Walsenburg, Colo., caused a rapid rise in the Cucharas River, which damaged property in Walsenburg to the extent of approximately $185,000. On August 6 heavy rains in the Fountain River drainage area immediately north of Pueblo, Colo., caused a sharp rise in that stream. Although flood stage was not reported, the losses due to the rapidly rising river amounted to approximately $41,000.

Unusually low stages prevailed in the Mississippi River and tributaries, and all-time records of low stages were broken at a number of stations. At St. Louis, Mo., the river reached −4.1 feet on the 28th which is the lowest free water stage ever recorded, and 1.1 feet lower than the previous record in 1934. The lowest ice-jam stage was −4.6 on December 29–30, 1933. At Arkansas City, Ark., a stage of −5.0 feet was reached on the 30th, or 1.4 feet lower than the low stage of November 1895.

Table of flood stages during August 1936

[All dates in August, unless otherwise specified]

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
ATLANTIC SLOPE DRAINAGE	*Feet*			*Feet*	
Little: Kenly, N. C	8	July 31	3	10.3	3
Neuse:					
Neuse, N. C	14			13.8	1
Smithfield, N. C	13	July 31	3	17.0	1
Goldsboro, N. C	14	3	8	17.2	6
Kinston, N. C	14	6	10	15.3	9
Cape Fear: Lock no. 2, Elizabethtown, N. C	20	1	3	22.3	2
Santee:					
Rimini, S. C	12	13	17	13.0	16
Ferguson, S. C	12	15	18	12.3	17
Savannah: Ellenton, S. C	14	3	5	15.5	4
EAST GULF OF MEXICO DRAINAGE					
Apalachicola: Blountstown, Fla	15	{ 3	5	15.5	4
		13	17	16.8	14, 15
Choctawhatchee: Caryville, Fla	12	4	7	12.6	5
MISSISSIPPI SYSTEM					
Arkansas Basin					
Purgatoire: Higbee, Colo	2	7	7	4.5	7
Arkansas:					
Fort Lyon, Colo	6	7	7	6.7	7
Great Bend, Kans	5	12	12	5.4	12

WEATHER ON THE ATLANTIC AND PACIFIC OCEANS

[The Marine Division, I. R. TANNEHILL in charge]

NORTH ATLANTIC OCEAN, AUGUST 1936

By H. C. HUNTER

Atmospheric pressure.—Considerable contrasts were noted in barometric pressure over the North Atlantic region during August. Around the British Isles and to the southwestward as far as the Azores, pressure averaged considerably higher than normal. On the other hand, it averaged moderately lower than normal over the Greenland-Iceland area, where there was an almost continuous deficiency, sometimes rather large in amount, from the 13th to the 24th; and it averaged somewhat less than normal over the area from the Bahamas and Florida to Bermuda.

The extremes of pressure reported by vessels, namely 30.53 and 29.36 inches, indicate a smaller range than is usual for an entire month. The higher reading was noted on the Belgian motorship *Spidoleine* near 41° N., 27° W., during the forenoon of the 3d; the lower was reported by the Swedish motorship *Blankaholm*, near 58° N., 9° W., about daybreak on the 18th. Table 1 shows that readings a little lower than that of the *Blankaholm* were recorded at Julianehaab, Greenland, and Reykjavik, Iceland.

TABLE 1.—*Averages, departures, and extremes of atmospheric pressure (sea level), at selected stations, for the North Atlantic Ocean and its shores, August 1936*

Stations	Average pressure	Departure	Highest	Date	Lowest	Date
	Inches	*Inch*	*Inches*		*Inches*	
Julianehaab, Greenland	29.68	−0.14	30.00	31	29.28	22
Reykjavik, Iceland	29.71	−.10	30.12	25	29.24	23
Lerwick, Shetland Islands	29.91	+.11	30.42	26	29.36	3
Valencia, Ireland	30.12	+.20	30.39	{22, 23, 24, 25}	29.71	2
Lisbon, Portugal	30.01	−.01	30.22	11	29.94	13
Madeira	30.01	−.02	30.18	10	29.89	28
Horta, Azores	30.29	+.09	30.50	4	29.96	31
Belle Isle, Newfoundland	29.92	+.03	30.22	30	29.40	20
Halifax, Nova Scotia	30.00	−.01	30.34	22	29.60	24
Nantucket	30.01	+.02	30.31	1	29.68	24
Hatteras	30.04	+.04	30.26	1	29.83	10
Bermuda	30.11	−.03	30.26	12	29.90	25
Turks Island	29.97	−.07	30.03	8	29.89	25
Key West	29.96	−.02	30.09	1	29.84	20
New Orleans	30.00	+.02	30.17	4	29.82	10

NOTE.—All data based on a. m. observations only, with departures compiled from best available normals related to time of observation, except Hatteras, Key West, Nantucket, and New Orleans, which are 24-hour corrected means.

Cyclones and gales.—There were comparatively few winds of gale force over the North Atlantic waters, and but one instance has come to notice of any wind exceeding a strong gale (force 9). This occurrence, when force 11 was reached, was in the western Gulf of Mexico shortly before the month ended, and is mentioned in the description of tropical disturbances elsewhere in this issue.

A low-pressure area, of slight strength at first, moved northeastward well off the American coast, on a course roughly parallel to it, for a few days; and on the 10th and 11th, from near Sable Island to the area northeast of Newfoundland, showed considerable strength for the month and the latitude. A few reports of fresh gales and strong gales have been received in connection with this LOW.

About a week afterward, pressure was notably low for several days near and to the southward and southeastward of Iceland, with the result that vessels in far-northern waters between the 5th and 20th meridians of west longitude met fresh to strong gales. Chart IX presents the situation on the 18th, at about the time of greatest development of this LOW.

Tropical disturbances.—There is an account elsewhere in this issue of four tropical disturbances which affected either the Gulf of Mexico or the Atlantic waters near Florida during August. On the whole these were not important; and the later storm, mentioned as starting before the month closed (to be described in the September issue), was probably not well developed till the last day or two of August. Conditions on August 18, during the prevalence of the second tropical disturbance in the Gulf, appear on chart IX.

Fog.—From Cape Cod eastward to the 60th meridian, which is close to Sable Island, also to northward of the 45th parallel of latitude from near Newfoundland to the shores of Europe, fog was practically everywhere more prevalent than it had been during July, and it was generally more frequent than is expected during August. Among notable amounts of occurrence were: 21 days in the square 40° to 45° N., 65° to 70° W; 15 days each in the squares 45° to 50° N., 45° to 55° W; 11 days in 45° to 50° N., 20° to 25° W; and 9 days in 45° to 50° N., 5° to 10° W.

To southwestward of Cape Cod there was a little fog, but none was met south of Hatteras. In general there was but little between the 40th and 45th parallels, except to westward of the 60th meridian.

NORTH PACIFIC OCEAN, AUGUST 1936

By WILLIS E. HURD

Atmospheric pressure.—The average pressure situation over the North Pacific Ocean for August 1936 may be summarized briefly as consisting of a great high-pressure area which occupied the east-central and some of the northeastern part of the ocean; a moderate depression which covered most of the northern part of the Pacific; and a belt of equatorial low pressure which, in east longitudes, merged with the continental LOW over China and adjacent seas.

Pressures were appreciably above normal over the northern Aleutian region, especially at Kodiak (+.12 inch) and St. Paul (+.16); and over parts of the Far East, with maximum departure, +.12, at Chichishima, southeast of Japan.

TABLE 1.—*Averages, departures, and extremes of atmospheric pressure at sea level, North Pacific Ocean, August 1936, at selected stations*

Station	Average pressure	Departure from normal	Highest	Date	Lowest	Date
	Inches	*Inch*	*Inches*		*Inches*	
Point Barrow	29.78	−0.11	30.03	12	29.40	8
Dutch Harbor	29.92	+.06	30.39	20	29.48	14
St. Paul	29.94	+.16	30.36	19	29.50	31
Kodiak	29.98	+.12	30.30	14	29.54	11
Juneau	30.03	+.01	30.31	1	29.71	20
Tatoosh Island	30.04	+.04	30.18	24	29.67	31
San Francisco	29.91	−.01	30.09	9	29.79	20
Mazatlan	29.84	.00	30.00	9	29.76	26
Honolulu	29.99	−.02	30.07	13	29.89	16
Midway Island	30.04	−.04	30.18	9	29.90	31
Guam	29.80	−.02	29.86	1, 11	29.64	21, 22
Manila	29.73	−.01	29.84	6, 17	29.54	25
Naha	29.76	+.07	29.94	7, 8	29.24	24
Chichishima	29.88	+.12	30.00	5	29.70	21
Urakawa	29.83	--------	30.00	19	29.48	6

NOTE.—Data based on 1 daily observation only, except those for Juneau, Tatoosh Island, San Francisco, and Honolulu, which are based on 2 observations. Departures are computed from best available normals related to time of observation.

OCEAN GALES AND STORMS, AUGUST 1936

Vessel	Voyage		Position at time of lowest barometer		Gale began August	Time of lowest barometer August	Gale ended August	Lowest barometer	Direction of wind when gale began	Direction and force of wind at time of lowest barometer	Direction of wind when gale ended	Direction and highest force of wind	Shifts of wind near time of lowest barometer
	From—	To—	Latitude	Longitude									
NORTH ATLANTIC OCEAN			° ′	° ′				Inches					
Jefferson Myers, Am. S. S.	Norfolk	Cristobal	[1]11 34 N.	78 55 W.	[2]31	4p, 1	1	29.76	ENE	E, 4	NW	E, 7	None.
Edgehill, Am. S. S.	New Orleans	Liverpool	[1]40 03 N.	60 19 W.	10	5a, 10	10	29.76	SSE	SE, 8	S	SSE, 8	SE-SSE.
Montreal City, Br. S. S.	Fowey	Philadelphia	44 45 N.	54 35 W.	10	4p, 10	10	29.70	WSW	SSE, 9	WSW	SSE, 9	SSE-WSW.
Maasdam, Du. S. S.	Rotterdam	New York	45 13 N.	55 36 W.	10	4p, 10	10	29.57	SSE	SSE, 9	W	SSE, 9	SSE-WSW.
Cauto, Am. S. S.	Tampico	Baltimore	23 40 N.	88 35 W.	15	7p, 15	15	29.56	N	E, 5	SE	SE, 9	N-E-SE.
San Benito, Pan. S. S.	Galveston	Belize	24 43 N.	90 00 W.	16	4a, 16	16	29.83	ENE	ESE, 7	SE	ESE, 8	ENE-SE.
McKeesport, Am. S. S.	Dundee	Boston	58 30 N.	12 10 W.	17	4p, 17	18	29.43	S	WSW, 8	W	WSW, 9	S-WSW.
Willhilo, Am. S. S.	Cristobal	San Juan	12 06 N.	73 55 W.	17	4p, 17	18	29.72	NE	NE, 6	E	NE, 6	
Blankaholm, Swed. M. S.	Gothenburg	Baltimore	58 30 N.	9 08 W.	17	4a, 18	21	29.36	SW	SW, 9	SW	SW, 9	Steady.
Georgia, Dan. S. S.	Newcastle	Boston	58 06 N.	13 46 W.	20	6p, 20	20	29.70	W	W, 8	W	W, 8	None.
McKeesport, Am. S. S.	Dundee	do	54 15 N.	37 00 W.	21	8p, 21	2	29.66	SW	SW, 7	WNW	WSW, 8	SW-WSW.
Do	do	do	46 18 N.	54 15 W.	24	Mdt, 24	25	29.42	SSE	WSW, 7	W	SSE, 8	SSE-W.
Normandie, Fr. S. S.	Havre	New York	45 10 N.	43 51 W.	28	9a, 29	29	29.46	SSE	SSW, 7	NNW	SSW, 8	SSE-SSW-W.
Quaker City, Am. S. S.	Liverpool	Boston	[1]47 21 N.	50 15 W.	29	Noon, 29	30	29.72	NW	NW, 7	NNW	NNW, 8	NW-NNW.
Amapala, Hond, S. S.	Vera Cruz	New York	19 48 N.	94 48 W.	29	6p, 29	30	29.53	NW	W, 7	SE	S, 8	NW-W-S.
Cayo Mambi, Am. S. S.	New Orleans	Zamora	21 40 N.	97 00 W.	30	..., 30	30	29.52	SW	SE, 9	SE	E, 11	SW-E.
Georgia, Dan. S. S.	Newcastle	Boston	43 49 N.	63 00 W.	30	8a, 31	31	29.82	SE	SSW, 3	SSE	SE, 8	SSE-SSW.
NORTH PACIFIC OCEAN													
Nojima Maru, Jap. M. S.	Yokohama	Los Angeles	45 06 N.	152 54 W.	1	2p, 2	2	29.44	NW	WSW, 7	NW	NNW, 8	W-SW.
Edgar F. Luckenbach, Am. S. S.	Los Angeles	Balboa	19 30 N.	105 50 W.	5	4p, 5	5	29.85	NE	SE, 8	SE	SE, 8	NE-SE.
Selandia, Dan. M. S.	Macassar	Manzanillo	19 42 N.	106 28 W.	5	Mdt, 5	6	[3]29.65	NNE	E, 11	SE	ESE, 11	E-SE.
Cuzco, Am. S. S.	Los Angeles	do	[1]21 11 N.	107 54 W.	5	1a, 6	6	[3]29.74	NE	ESE, 9	SSE	ESE, 10	ESE-SE.
Willhilo, Am. S. S.	do	Balboa	20 58 N.	107 45 W.	5	3a, 6	6	29.54	E	SE, 10	SE	SE, 10	E-SE.
Bonita, Nor. M. S.	do	do	[1]20 15 N.	107 02 W.	5	7a, 6	6	29.39	NE	N, 10	WSW	NE, 11	NE-N-W.
Pres. Lincoln, Am. S. S.	Yokohama	Honolulu	32 19 N.	171 55 E.	11	3a, 11	11	29.40	NE	N, 7	S	NNE, 8	NE-N-SW.
Pres. McKinley, Am. S. S.	do	Victoria, B. C.	50 00 N.	171 06 W.	13	Mdt, 13	14	29.37	NNE	NNW, 8	SSW	NNW, 8	N-NW.
Kaiwo Maru, Jap. Bark.	Singapore	Tokyo	17 50 N.	118 20 E.	16	10a, 16	16	29.35	W	SW, 8	S	SW, 8	Steady.
Katrina Luckenbach, Am. S. S.	Los Angeles	Balboa	23 00 N.	111 07 W.	17	3p, 17	17	28.82	NE	WNW, 12	WSW	NE, 12	NE-WNW-W.
Tatsuna Maru, Jap. S. S.	do	do	24 28 N.	112 23 W.	18	2a, 18	18	29.69	NW	W, 8	SW	WSW, 8.	W-SW.
Tatsuta Maru, Jap. M. S.	Yokohama	Honolulu	33 26 N.	166 03 E.	24	11p, 24	25	29.26	ENE	S, 7	S	SSW, 8	NNE-S-SSW.
Fukuyo Maru, Jap. S. S.	Muroran	Coos Bay	49 40 N.	176 33 W.	27	6p, 28	29	29.43	E	NE, 8	N	NE, 8	1 point.
Tokai Maru, Jap. M. S.	Yokohama	Los Angeles	46 17 N.	179 10 E.	30	2a, 31	31	[3]29.00	E	SSW, 8	SSW	SSW, 8	E-SSW.
Empress of Japan, Br. S. S.	do	Honolulu	31 00 N.	172 47 E.	31	2p, 31	[4]1	29.37	SSE	S, 8	SSW	S, 10	SE-S-SSW.
Fukuyo Maru, Jap. S. S.	Muroran	Coos Bay	50 04 N.	167 55 W.	30	4p, 30	[4]2	29.43	SSW	SSW, 7	WSW	SSW, 8	None.

[1] Position approximate. [2] July. [3] Barometer uncorrected. [4] September.

Extratropical cyclones and gales.—Cyclonic activity in August increased only slightly over that of the previous month in extratropical waters. Whereas there were 5 days with scattered gales in northern waters in July, there were 8 days with such gales, unassociated with tropical disturbances, in August. On 7 days the highest winds reported were of force 8, but it was not until the 31st that a whole gale (force 10 from south) was reported. This was experienced by the British steamship *Empress of Japan*, barometer 29.37, in 31°00′ N., 172°47′ E. Of the gales reported by ships, 6 occurred along the central part of the northern route; the remainder, between 30°-35° N., 165°-175° E. The lowest extratropical pressure reading reported was 29.00 inches (uncorrected), observed on the Japanese motorship *Tokai Maru*, on the 31st, near 46° N., 179° E.

Typhoons.—Subjoined is a report by the Rev. Bernard F. Doucette, of the Manila Observatory, on three typhoons and two depressions which occurred in Far Eastern waters during the month. The typhoon of August 11–18, which is especially noted as being intense from northern Luzon westward over Hong Kong to Siam, and that of the 21st to 30th, which caused great loss of life over southern Chosen (Korea) on the 27th, were of major importance.

Hurricanes in Mexican west coast waters.—Two tropical cyclones, both of which were of hurricane intensity along portions of their paths, occurred during the month along the Mexican west coast. The earlier, that of the 5th–8th, appears to have originated approximately 100 miles southwest of Manzanillo. It pursued a course along the entire length of the Gulf of California, and dissipated over southern California. During the afternoon of the 5th the American steamer *Edgar F. Luckenbach* encountered strong winds southwest of Cape Corrientes, maximum force 8, southeast, barometer 29.85, in 19½° N., 105°50′ W. At 10 p. m. the Norwegian motorship *Bonita*, southbound, ran into an east-northeasterly gale of force 9, increasing at 11 p. m., to force 10, in approximately 21° N., 108° W. Farther south, at 2 a. m. of the 6th, the gale, continuing from east-northeast, had increased to force 11. At 6 a. m. the winds, of like force, had changed to north-northeast. The lowest barometer, 29.39, occurred an hour later, with wind north, force 10, at or near the entrance to the Gulf of California.

From about midnight of the 5th until 2 a. m. of the 6th, the Danish motorship *Selandia* experienced east to southeast gales of force 11 in the vicinity of 19°40′ N., 106°20′ W. The S. S. *Cuzco*, also in the lower part of the Gulf of California, was likewise heavily involved, especially from 1 to 3 a. m., of the 6th, with the maximum wind, ESE., force 10 and "terrific rain squalls which almost beat the sea down."

At local noon of the 6th the storm center was close to 23° N., 109° W. The S. S. *Paul Luckenbach* reported a whole west gale (force 10), barometer 29.53, at 12:30 p. m., in 22°22′ N., 109°29′ W. In an interesting special description of the storm, the ship's observer, J. R. Withers, noted that a noon radio interception from the S. S. *Griffco*, in 23°22′ N., 109°15′ W., gave a maximum wind force 12, northeast, barometer 29.42.

During the 7th the storm, in its passage up the Gulf, probably maintained much of its energy, since at the p. m. observation a radio message received from the British motorship *Riley*, then off the east coast of Lower California, across the Gulf from Guaymas, reported a force of 10, northwest, barometer 29.38. Thereafter the cyclone

diminished in energy to that of a mere depression after going inland at the head of the Gulf.

The succeeding hurricane, that of the 17th–18th, was first definitely located on the morning of the 17th south of Cape San Lucas. The storm moved at great speed up the west coast of Lower California, was centered with much lessened intensity in approximately 26° N., 114° W., 24 hours later, and thereafter disappeared from observation. Vessels that made special reports on the cyclone mentioned the rapidity with which the cyclone made up relative to their positions. The S. S. *Antigua*, Captain Beyer, reported that "the wind shifts were fast." Second Officer J. Bronold, of the S. S. *Katrina Luckenbach*, said there were no advance warnings of the storm, but that the wind increased sharply to a gale, the wind becoming northeast, force 8, at 10 a. m. of the 17th. It was northeast 9 at 10:50 a. m., in 22°40′ N., 110°38′ W., barometer 29.43, with mountainous seas which swept over the deck, and torrential rain. The ship lay hove to. Visibility was nil. At local noon, in 22°48′ N., 110°50′ W., the wind increased to a hurricane which continued until 2:30 p. m., when the wind shifted to west-northwest. The lowest barometer, 28.82, occurred at this time, in 23°00′ N., 111°07′ W. At 6 p. m. the ship, with rapidly rising barometer and moderating winds, resumed her course.

In a copy of intercepted radio reports received by the S. S. *Antigua*, Chief Officer Croft lists one ship other than the *Katrina Luckenbach* which encountered hurricane winds on the afternoon of the 17th. That was the British steamer *Ontariolite*, in 22°55′ N., 110°36′ W., at 5 p. m., local time, with the accompaniment of no visibility and dangerous seas.

On the 18th the final report of gale winds in connection with this storm was furnished by the Japanese steamer *Tatsuna Maru* which had a west wind of force 8, barometer 29.69, early in the morning, in 24°28′ N., 112°23′ W.

The principal reported damage done by this storm was to tuna fishing boats and other small craft that had taken refuge in Magdalena Bay prior to the blow. Some of these were washed ashore and damaged; and one boat, the *Enterprise*, was reported as wrecked on Crescienta Island, from which the crew of 12 was rescued by the Panama Pacific liner *California*.

Fog.—Fog continued frequent along the central and western parts of the northern steamship routes, where it occurred on 15 to 40 or more percent of the days, well distributed through the month. East of 160° W. fog was much less frequent and was observed mostly about the middle of August. Widely scattered fog occurred on a few days in middle latitudes. There were 4 days with fog reported off the Washington coast and 12 days with fog off the California coast.

TYPHOONS AND DEPRESSIONS OVER THE FAR EAST, AUGUST 1936

By Rev. BERNARD F. DOUCETTE, S. J.

[Weather Bureau, Manila, P. I.]

Three typhoons and two depressions during the month of August 1936 are briefly described below.

Typhoon, August 6 to 14.—A depression formed about 350 miles east-southeast of Yap and intensified as it moved rapidly west-northwest, then northwest, as it crossed the one hundred and thirtieth meridian. It continued to the Balintang Channel, shifting to the West when about 60 miles southwest of Basco. In 2 days it reached the Gulf of Tong King and filled up rapidly as it entered the continent.

At Basco, Batanes Islands, the barometric minimum as the typhoon approached the locality from the southeast was about 746.7 mm (29.389 inches).

Typhoon, August 11 to 18.—A depression appeared about 300 miles east-southeast of Yap, August 11, moving westerly, and developed into a typhoon when about 120 miles south of Yap. Taking a northwesterly course, it moved rapidly toward northern Luzon passing close to and north of Aparri during the evening of August 15. Continuing on this course, it crossed the China Sea and passed close to and south of Hong Kong, August 17. It was followed for 1 more day into the continent, the last information received being a forecast from Siam stating that the disturbance "was intense west of Laokay" the afternoon of August 18. (Position of Laokay, latitude 22°.30 N., longitude 103°.57 E.)

Aparri reported a minimum of 711.42 mm (28.009 inches) gravitation correction applied, with west-northwest winds of force 10, August 15, 9.16 p. m. Laoag had 726.25 mm (28.592 inches) as its minimum with southwest winds, force 6, August 16, 1 a. m. Basco, Batanes Islands, north of the path of the typhoon, had 730.70 mm (28.768 inches) with east-southeast winds, force 8, August 16, 2 a. m. As the typhoon approached Pratas the 2 p. m. observation broadcast was 737.1 mm (29.020 inches), northeast winds force 12. From newspapers it was learned that the minima observed at Hong Kong and Gap Rock were 29.07 inches (Aug. 17, 3 a. m.) and 28.53 inches (Aug. 17, 4 a. m.), respectively. At the Royal Observatory in Hong Kong, winds reached the velocity of 131 miles per hour in two gusts (Aug. 17, 3.30 a. m. and 4 a. m.)

The loss of life due to this typhoon as it passed the Philippines was 7, with 10 persons reported missing, according to the newspapers of August 19. In Hong Kong a score of lives were lost. In the Philippines the United States Coast and Geodetic Survey vessel *Fathomer* was forced aground in the Port San Vicente harbor, a short distance east-northeast of Aparri. The ship was fighting winds of force 12, which threw her upon the beach. As the harbor is not large, there were no large waves to damage the ship, and she was refloated later without much difficulty. Meteorological data obtained by the officers of the vessel have not arrived at the Observatory at the present writing. In and around Hong Kong the S. S. *Sunning* was a total loss and at least 10 other ships were forced aground. This typhoon was considered the worst disaster there due to weather since 1923.

Depression, August 18 to 22.—A mild depression of little importance formed southwest of Guam, moved northwest, gradually inclining to the west-northwest, and disappeared when about 400 miles east of Batanes Islands.

Typhoon, August 21 to 30.—About 300 miles north of Guam a depression formed, moved west, and then gradually inclined to the west-northwest and northwest. It developed into a storm of considerable intensity as it approached Naha, Nansei Islands. When about 100 miles south-southeast of Naha, it changed its course to the west-northwest, thus moving into the Eastern Sea, where it recurved to the northeast (Aug. 26) when about 200 miles away from the continent. After recurving it moved rapidly northeastward across Japan Sea toward Saghalin Island. One thousand five hundred and sixteen lives were lost as the typhoon crossed southeastern Korea.

Depression, August 24 to 28.—A depression was indicated over the China Sea, August 24, which intensified somewhat while remaining stationary for 2 days about

300 miles west of northern Luzon. It then moved northwest and west, passing over the northern part of Hainan Island and across the Gulf of Tong King into Indochina.

SEA-SURFACE TEMPERATURE SUMMARY FOR THE OUTER FLORIDA STRAIT, 1912-33

By GILES SLOCUM

The monthly mean sea-surface temperatures in the area directly east of the Florida peninsula, for the period January 1912 to December 1933 inclusive, are given in the accompanying table.

The area from which these temperature observations were taken embraces five 1° squares, namely: Between 25° N. and 30° N. and between 79° W. and 80° W. This area nearly coincides with the confines of the Gulf Stream in these latitudes.

This is the seventh of a series of similar temperature-history tabulations of sea surface temperatures for small areas in American waters. The first of the series appeared in the November 1934 issue of the MONTHLY WEATHER REVIEW, and the last previous tabulation appeared in the June 1935 issue.

Monthly and annual mean sea-surface temperatures in the outer Florida Strait, 1912 to 1933, inclusive

Year	Total number of observations for the year	January	February	March	April	May	June	July	August	September	October	November	December	Annual
1912	673	74.4	73.5	75.8	78.0	79.9	81.2	81.9	83.6	83.0	81.2	78.2	77.4	79.0
1913	606	76.1	75.6	77.0	75.6	77.5	80.4	81.8	82.1	82.1	80.3	77.1	75.5	78.4
1914	484	74.4	74.3	72.6	76.1	78.3	81.4	83.4	83.8	82.8	81.1	78.9	77.7	78.7
1915	319	76.3	74.2	75.5	74.9	78.6	80.8	84.4	83.8	83.0	81.9	79.7	75.4	79.0
1916	228	76.0	75.4	72.6	75.2	79.3	81.6	82.7	82.8	82.3	80.1	76.9	74.8	78.3
1917	142	74.9	73.0	75.8	76.6	77.5	81.0	82.3	82.9	83.0	79.6	76.0	74.7	78.1
1918	54	73.6	76.0	76.3	76.0	78.8	82.0	81.2	83.2	82.6	80.8	80.2	76.0	78.9
1919	137	73.1	72.3	76.9	77.2	78.3	80.8	82.1	83.8	82.1	81.7	78.3	77.5	78.7
1920	308	75.4	74.9	74.4	77.7	78.0	80.5	82.4	82.5	83.3	80.0	78.0	75.7	78.6
1921	560	75.6	75.1	75.3	76.4	77.5	80.8	82.6	82.8	83.0	81.6	78.6	76.7	78.8
1922	743	76.2	74.9	75.7	77.6	79.2	82.3	82.8	83.1	82.9	81.1	79.3	77.5	79.4
1923	852	75.8	75.6	76.0	77.8	78.9	80.8	82.2	83.0	82.7	81.2	77.3	77.1	79.0
1924	1,111	76.3	74.2	74.0	77.1	79.2	82.6	84.2	84.5	83.8	80.2	77.3	76.0	79.1
1925	1,163	76.3	75.1	75.4	76.7	78.9	81.3	82.6	84.0	83.7	82.6	79.9	76.5	79.4
1926	1,239	75.0	74.7	74.8	77.7	79.0	81.7	83.5	84.0	83.8	82.0	78.8	77.5	79.4
1927	1,352	75.5	76.3	76.0	77.3	79.6	82.4	83.6	84.4	83.7	81.6	79.1	76.7	79.7
1928	1,399	74.2	74.7	75.2	76.5	77.6	81.7	82.9	84.0	83.2	81.8	79.0	76.8	79.0
1929	1,296	75.8	76.0	76.5	78.1	79.9	80.8	81.9	83.0	82.4	80.4	79.6	77.9	79.4
1930	1,216	76.8	75.9	76.4	77.1	79.5	80.4	82.8	83.9	83.3	80.9	77.9	75.9	79.2
1931	1,230	75.2	73.8	73.9	75.6	78.4	80.9	83.7	84.1	83.4	81.5	78.4	78.7	79.0
1932	1,130	76.9	76.7	76.6	75.5	78.6	81.6	83.8	84.5	83.3	81.7	79.6	77.4	79.7
1933	1,243	75.6	76.0	76.1	77.1	79.8	81.1	82.9	83.6	83.4	81.2	78.8	76.8	79.4
Mean (1912-33)	-----	75.4	74.9	75.4	76.7	78.7	81.3	82.8	83.5	83.0	81.1	78.5	76.6	79.0

CLIMATOLOGICAL TABLES

CONDENSED CLIMATOLOGICAL SUMMARY

In the following table are given for the various sections of the climatological service of the Weather Bureau the monthly average temperature and total rainfall; the stations reporting the highest and lowest temperatures, with dates of occurrence; the stations reporting the greatest and least total precipitation; and other data as indicated by the several headings.

The mean temperature for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperatures and precipitation are based only on records from stations that have 10 or more years of observations. Of course, the number of such records is smaller than the total number of stations.

Condensed climatological summary of temperature and precipitation by sections, August 1936

[For description of tables and charts, see REVIEW, January p. 29]

Section	Temperature								Precipitation					
	Section average	Departure from the normal	Monthly extremes						Section average	Departure from the normal	Greatest monthly		Least monthly	
			Station	Highest	Date	Station	Lowest	Date			Station	Amount	Station	Amount
	°F.	°F.		°F.			°F.		In.	In.		In.		In.
Alabama	80.9	+1.2	2 stations	103	[1] 17	2 stations	51	[1] 1	5.73	+1.20	Ozark	11.84	Belgreen	1.51
Arizona	81.0	+1.3	Buckeye	120	14	Fort Valley	36	22	2.24	-.12	Williams	6.20	Yuma Valley	T
Arkansas	85.0	+5.0	Ozark	120	10	2 stations	43	1	.44	-3.14	Springbank	2.37	8 stations	.00
California	73.4	+1.0	Greenland Ranch	126	6	Portola	24	[1] 23	.13	+.03	Seven Oaks	2.55	91 stations	.00
Colorado	68.0	+2.6	Las Animas	109	17	Pearl	23	28	2.65	+.68	Pagosa Springs (near)	9.81	2 stations	.22
Florida	81.5	+.1	Raiford	100	26	Quincy	59	31	6.76	-.27	Blountstown	17.41	Palatka	2.14
Georgia	80.3	+.8	4 stations	103	[1] 19	2 stations	46	31	6.41	+1.16	Griffin	12.50	Douglas	1.69
Idaho	67.4	+1.0	2 stations	107	[1] 5	Bostetter	18	29	.82	+.16	Blackfoot Dam	2.76	2 stations	.00
Illinois	81.0	+6.9	do	111	[1] 17	Mount Carroll	47	1	2.66	-.68	Sycamore	10.94	Du Quoin	.04
Indiana	79.4	+5.9	Seymour	111	22	Marengo	43	31	3.04	-.34	La Porte	8.16	Shoals	.47
Iowa	79.2	+7.2	Sac City	114	18	2 stations	46	[1] 1	3.48	-.06	Britt	8.68	Keokuk	.78
Kansas	85.3	+7.7	2 stations	119	[1] 12	do	47	29	1.06	-2.07	Scott City (near)	4.40	2 stations	.00
Kentucky	81.1	+5.3	4 stations	108	[1] 17	Greensburg	43	31	2.22	-1.48	Paintsville	7.55	3 stations	.25
Louisiana	83.1	+1.3	Plain Dealing	114	10	Robeline	56	1	4.42	-.62	Burrwood	12.67	Shreveport	.39
Maryland-Delaware	75.7	+2.6	2 stations	101	[1] 21	2 stations	39	1	4.30	-.29	Salisbury, Md	9.84	Cumberland, Md	1.44
Michigan	69.0	+2.2	Adrian	105	22	Dukes	32	20	3.45	+.75	Luther	7.59	Detroit	1.07
Minnesota	70.7	+3.4	St. Paul	108	15	Meadowlands	34	31	2.93	-.24	Zumbrota	7.01	Fosston	.75
Mississippi	82.6	+1.9	Tunica	108	[1] 18	Batesville	51	31	2.39	-1.85	Port Gibson	6.35	Yazoo City	.12
Missouri	84.6	+8.2	Clinton	116	16	Dean	43	1	.84	-3.00	Jefferson City	3.48	Cape Girardeau	T
Montana	67.4	+2.6	Garland	108	9	Wisdom	24	25	.99	-.14	Cut Bank	4.94	Heron	.03
Nebraska	79.4	+6.4	Pawnee City	117	13	Gordon	34	29	1.62	-1.15	Tekamah	5.32	Sappa Valley	.28
Nevada	72.9	+2.4	Logandale	112	24	2 stations	33	[1] 23	.53	+.02	Sharp	2.08	2 stations	.00
New England	67.1	+.3	2 stations	97	[1] 3	First Conn. Lake, N. H.	33	[1] 21	4.11	+.26	Blue Hill, Mass	7.48	Block Island, R. I.	1.11
New Jersey	74.2	+2.4	Elizabeth	101	4	3 stations	44	[1] 1	4.14	-.61	Belvidere	6.97	Belleplain	2.68
New Mexico	71.7	+1.1	San Marcial	110	2	Therma	25	26	2.07	-.41	Ramah	7.02	2 stations	.00
New York	69.3	+1.9	2 stations	100	[1] 9	Gabriels	32	[1] 18	4.19	+.42	Honk Falls	11.73	Lewiston	.83
North Carolina	77.3	+1.4	Lumberton	100	27	Mount Mitchell	36	31	4.68	-.82	Beaufort	12.49	Reidsville	1.21
North Dakota	69.8	+3.6	2 stations	110	1	Cavalier	29	26	1.40	-.74	Pembina	4.44	Fullerton	.24
Ohio	76.1	+4.5	Gallipolis (near)	108	[1] 21	Canfield	42	18	3.59	+.20	Alliance	8.87	Catawba Island	.98
Oklahoma	88.0	+6.6	2 stations	120	[1] 10	Smithville	45	1	.21	-2.71	Clinton	1.25	13 stations	.00
Oregon	66.2	+.8	5 stations	105	[1] 5	Fremont	23	25	.16	-.26	Astoria	1.31	43 stations	.00
Pennsylvania	73.2	+3.1	2 stations	102	[1] 21	3 stations	37	[1] 1	4.96	+.73	Ebensburg	9.48	Erie	1.28
South Carolina	79.7	+.8	Dillon	103	[1] 4	Long Creek (near)	48	31	4.84	-.85	Columbia	9.82	Dillon	1.04
South Dakota	76.3	+5.7	Gannvalley	116	24	Pine Ridge	38	29	1.59	-.54	Wentworth	5.86	Camp Crook	.15
Tennessee	80.6	+4.0	Carthage	108	21	Waynesboro	44	31	2.21	-1.78	Kingsport	6.38	Union City	.17
Texas	84.4	+1.6	Seymour	120	12	2 stations	50	[1] 2	1.47	-.84	Raymondville	9.36	19 stations	.00
Utah	70.4	+.7	St. George	106	23	Clear Creek	27	28	1.59	+.53	Kimberly	4.70	Wendover	.30
Virginia	76.4	+2.4	Columbia	104	4	2 stations	45	31	3.65	-.68	Pinnacles	8.20	Timberville	.78
Washington	66.6	+1.0	Wahluke (near)	111	5	Deer Farm (near)	28	26	.52	-.32	Clearwater	4.27	8 stations	.00
West Virginia	75.2	+3.5	4 stations	105	[1] 11	Bayard	36	1	3.96	-.12	Jane Lew	7.44	Cairo	1.49
Wisconsin	70.7	+3.3	Meadow Valley	104	9	Long Lake	34	31	5.15	+1.92	Stoughton	9.11	West De Pere	2.29
Wyoming	66.1	+2.3	Buffalo	106	24	Gallatin	22	28	1.27	+.17	Middle Forks	3.46	Sheridan Field Station.	.07
Alaska (July)	57.4	+1.6	Ruby	98	2	Barrow	24	8	2.74	-.21	Cordova	10.72	University Experiment Station.	.46
Hawaii	75.0	+.2	Papohaku	93	[1] 22	Kanalohuluhulu	51	11	10.00	+3.33	Piihonua	46.00	2 stations	.00
Puerto Rico	78.9	-.6	Corozal	99	[1] 7	Guineo Reservoir	53	[1] 1	10.76	+3.58	La Mina (El Yunque).	36.61	Santa Rita	1.23

[1] Other dates also.

TABLE 1.—*Climatological data for Weather Bureau stations, August 1936*

[Compiled by Annie Small, by official authority, U. S. Weather Bureau]

District and station	Elevation of instruments: Barometer above sea level	Elevation: Thermometer above ground	Elevation: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to means of 24 hours	Pressure: Departure from normal	Temperature: Mean max. + mean min. ÷ 2	Temperature: Departure from normal	Maximum	Date	Mean maximum	Minimum	Date	Mean minimum	Greatest daily range	Mean wet thermometer	Mean temperature of the dew-point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Days with 0.01 inch, or more	Wind: Total movement	Wind: Prevailing direction	Maximum velocity: Miles per hour	Maximum velocity: Direction	Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	Ft.	Ft.	In.	In.	In.	° F.	° F.	° F.		° F.	° F.		° F.	° F.	° F.	° F.	%	In.	In.		Miles								0-10	In.	In.
New England							67.7	+0.2										79	3.29	−0.3										5.6		
Eastport	76	67	85	29.92	30.00	+0.04	60.0	−0.7	84	2	68	48	27	52	29	57	55	86	2.38	−0.6	14	5,687	sw.	26	se.	30	4	11	16	6.9	0.0	0.0
Greenville, Maine	1,070	6	40	28.85	30.00	----	60.5	----	81	9	70	38	21	51	31	----	----	----	2.47	----	13	3,129	se.	15	----	17	8	9	14	----	.0	.0
Portland, Maine	103	82	117	29.88	30.00	+.02	67.2	+.8	95	4	75	58	18	60	30	59	55	70	2.05	−1.1	9	5,641	n.	21	se.	29	20	3	8	3.8	.0	.0
Concord	289	60	----	----	----	----	67.0	+.2	93	16	79	45	18	56	34	----	----	----	3.75	−.2	8	----	ne.	----	----	----	18	8	5	----	.0	.0
Burlington	403	11	48	29.55	29.98	+.01	65.8	−2.1	87	8	76	45	18	56	33	59	55	71	3.94	+.6	11	5,636	s.	26	s.	19	6	11	14	6.5	.0	.0
Northfield	876	12	60	29.08	30.01	+.03	62.7	−.7	89	16	75	38	28	50	38	58	56	81	5.54	+2.0	12	4,929	s.	27	ne.	16	5	14	12	6.6	.0	.0
Boston [1]	20	31	50	29.97	30.00	+.01	69.7	−.2	94	16	78	54	22	61	28	63	60	77	5.15	+1.5	11	6,452	e.	27	n.	17	9	13	9	5.4	.0	.0
Nantucket	12	14	90	30.00	30.01	+.02	67.6	−.2	82	24	73	55	19	62	20	64	62	86	2.84	−.6	10	9,952	sw.	34	sw.	30	10	9	12	5.7	.0	.0
Block Island	26	11	46	29.98	30.01	+.02	69.0	+.5	82	25	75	58	26	63	17	65	64	88	1.11	−2.6	9	9,733	sw.	34	w.	23	7	17	7	5.7	.0	.0
Providence	160	215	251	29.84	30.01	+.02	71.6	+.6	93	17	81	53	28	62	31	64	60	74	3.00	−.5	12	6,843	nw.	32	nw.	31	8	16	7	5.2	.0	.0
Hartford	159	70	104	29.84	30.01	+.02	71.6	+2.7	94	4	82	54	18	62	29	----	----	----	4.22	−.1	14	5,399	s.	25	nw.	31	9	15	7	5.0	.0	.0
New Haven	106	74	153	29.90	30.02	+.03	72.0	+1.7	93	4	80	56	28	64	25	65	62	74	2.22	−2.0	11	6,390	s.	24	sw.	24	7	14	10	5.7	.0	.0
Middle Atlantic States							75.4	+2.1										74	3.86	−0.4										5.5		
Albany	97	97	112	29.90	30.00	+.02	71.4	+.6	97	16	82	53	28	61	34	63	58	69	6.54	+2.8	12	4,965	s.	25	nw.	10	12	11	8	4.8	.0	.0
Binghamton	871	57	79	29.10	30.01	+.02	71.4	+3.4	97	3	83	43	18	59	41	----	----	----	6.70	+3.1	17	3,961	ne.	30	w.	19	6	10	15	6.7	.0	.0
New York	314	415	454	29.68	30.00	.00	74.1	+1.0	93	4	82	58	31	66	27	66	63	75	3.68	−.6	15	8,922	sw.	47	n.	23	10	11	10	5.5	.0	.0
Harrisburg	374	94	104	29.61	30.00	−.01	75.0	+2.4	96	23	84	55	18	66	27	67	63	71	2.97	−1.1	17	4,621	w.	24	ne.	10	7	14	10	5.9	.0	.0
Philadelphia	114	174	367	29.91	30.03	+.03	76.0	+1.2	95	25	84	58	31	68	25	68	64	70	3.30	−1.3	11	8,118	sw.	32	sw.	16	8	13	10	5.3	.0	.0
Reading	323	283	306	29.67	30.01	----	75.0	+2.6	94	23	84	57	18	66	27	66	63	72	4.87	+.7	11	6,782	sw.	43	n.	23	8	15	8	5.4	.0	.0
Scranton	805	72	104	29.16	30.01	+.01	72.4	+2.6	95	23	83	43	18	62	36	63	59	70	4.58	+.9	17	4,115	sw.	34	nw.	23	5	18	8	5.7	.0	.0
Atlantic City	52	37	172	29.96	30.01	+.01	74.2	+1.7	93	24	80	60	31	68	21	69	66	80	3.01	−1.5	10	10,586	s.	37	w.	25	6	14	11	6.3	.0	.0
Sandy Hook	22	10	57	29.99	30.01	----	74.3	+1.8	93	3	81	61	31	68	23	68	66	80	2.98	−2.0	12	8,739	sw.	40	n.	23	12	10	9	4.5	.0	.0
Trenton	190	88	106	29.81	30.01	----	74.4	+1.4	95	23	84	57	28	65	30	67	63	73	4.11	−.6	11	6,274	s.	29	nw.	25	8	12	11	5.6	.0	.0
Baltimore	123	100	215	29.89	30.01	.00	78.2	+2.7	97	25	87	59	31	70	27	69	65	68	4.60	+.2	12	7,196	sw.	32	w.	29	14	8	9	5.0	.0	.0
Washington	112	62	85	29.89	30.01	.00	77.9	+2.9	98	23	87	59	2	69	20	69	66	71	3.61	−.4	9	4,275	sw.	30	nw.	22	11	10	10	5.4	.0	.0
Cape Henry	18	8	54	30.00	30.02	----	78.8	+1.9	97	23	86	60	2	72	23	73	70	80	1.03	−3.8	8	7,706	sw.	26	n.	31	10	16	5	5.0	.0	.0
Lynchburg	686	5	----	29.32	30.05	+.03	77.8	+2.2	99	20	90	54	1	66	36	----	----	----	5.95	+2.2	14	----	sw.	----	----	----	4	23	4	----	.0	.0
Norfolk	91	80	125	29.94	30.04	+.04	79.6	+2.2	96	5	87	64	2	72	24	72	70	79	1.77	−3.4	10	6,378	sw.	31	w.	16	8	9	14	6.3	.0	.0
Richmond	144	11	52	29.89	30.04	+.03	79.0	+2.5	97	4	89	59	1	69	29	71	68	77	2.90	−1.5	9	5,221	sw.	30	nw.	16	10	12	9	5.3	.0	.0
Wytheville	2,304	49	55	----	30.02	+.01	73.0	+2.5	95	20	84	53	31	62	31	----	----	78	2.94	−1.2	11	4,088	w.	21	nw.	14	10	12	9	----	.0	.0
South Atlantic States							80.1	+2.0										80	5.26	−0.4										4.9		
Asheville	2,253	89	104	27.78	30.06	+.04	74.8	+4.3	94	20	86	52	31	64	32	66	64	82	3.40	−.8	10	4,345	s.	30	n.	27	9	16	6	4.9	.0	.0
Charlotte	779	63	86	29.24	30.06	+.04	79.4	+2.3	95	26	89	60	31	70	26	71	69	77	4.30	−.8	13	4,327	sw.	22	nw.	16	10	14	7	4.9	.0	.0
Greensboro	886	6	56	29.12	30.06	----	77.3	----	96	20	88	52	31	67	28	71	69	84	2.04	----	10	4,638	sw.	22	nw.	27	8	15	8	5.5	.0	.0
Hatteras	11	5	50	30.03	30.04	+.04	79.5	+1.5	90	24	84	65	3	75	19	74	72	79	5.03	−.7	10	7,613	sw.	28	n.	8	15	8	8	4.7	.0	.0
Raleigh	376	103	146	29.64	30.02	+.01	79.4	+2.4	95	5	88	61	31	70	23	73	70	80	2.55	−2.9	10	5,286	sw.	23	nw.	27	7	18	6	4.9	.0	.0
Wilmington	72	73	107	29.98	30.05	+.05	80.3	+2.7	95	26	88	65	31	72	26	74	72	83	4.32	−2.0	14	5,301	s.	22	nw.	24	9	15	7	4.7	.0	.0
Charleston	48	11	92	30.00	30.05	+.04	81.6	+.6	96	26	88	68	1	75	24	76	73	79	6.37	−.2	13	6,235	s.	40	ne.	25	7	14	10	5.5	.0	.0
Columbia, S. C.	347	70	91	29.68	30.05	+.04	81.0	+1.4	97	27	90	61	31	72	24	73	70	78	9.82	+4.4	13	4,212	se.	27	nw.	29	13	15	3	4.3	.0	.0
Greenville, S. C.	1,039	139	----	----	----	----	78.0	+2.2	99	29	88	57	1	69	29	----	----	----	4.49	−1.0	11	----	ne.	----	----	----	15	10	6	----	.0	.0
Augusta	182	62	77	29.84	30.02	+.01	82.0	+1.6	98	26	91	63	31	73	23	74	72	79	8.31	+3.3	12	3,654	s.	28	s.	29	8	17	6	4.9	.0	.0
Savannah	65	73	152	29.97	30.04	+.03	83.0	+2.3	99	26	92	69	1	74	24	75	73	82	3.23	−4.1	11	6,060	s.	27	e.	21	12	13	6	4.8	.0	.0
Jacksonville	43	86	110	29.99	30.04	+.03	82.1	+.4	95	25	90	71	10	74	21	75	73	81	5.99	+.2	13	5,073	e.	24	sw.	12	14	12	5	4.5	.0	.0
Florida Peninsula							82.4	+0.2										79	7.89	+1.6										5.1		
Key West	22	10	64	29.94	29.96	−.02	82.8	−.7	90	2	88	72	5	78	14	77	75	78	7.52	+3.0	22	6,348	e.	26	se.	14	12	11	8	5.1	.0	.0
Maimi	25	124	168	29.97	30.00	−.02	82.1	+.7	90	9	87	70	6	77	14	76	74	77	8.55	+2.4	17	6,674	e.	25	se.	22	8	16	7	5.6	.0	.0
Tampa	35	88	197	29.98	30.01	+.01	82.2	+.7	94	29	90	70	7	74	22	75	73	82	7.59	−.6	17	7,000	e.	40	ne.	3	11	17	3	4.7	.0	.0
Titusville	43	5	36	29.97	30.02	----	80.6	----	95	26	89	68	7	72	24	----	----	----	6.19	----	12	----	se.	----	----	----	12	14	5	----	.0	.0
East Gulf States							81.3	+1.5										79	5.30	0.0										4.6		
Atlanta [1]	976	5	53	29.03	30.03	+.02	79.8	+2.8	97	18	90	59	1	70	26	72	69	78	5.95	+1.5	11	4,391	ne.	30	n.	10	7	18	6	5.4	.0	.0
Macon	370	79	87	29.64	30.03	+.02	81.2	+1.3	98	27	91	61	31	71	27	74	72	79	5.25	+.9	10	3,963	e.	27	ne.	17	9	15	7	4.9	.0	.0
Thomasville	273	49	58	29.74	30.03	+.03	80.6	−.4	96	27	90	64	31	71	24	74	72	82	7.95	+2.2	15	----	e.	----	----	----	7	14	10	----	.0	.0
Apalachicola	35	11	----	29.97	30.01	----	81.1	----	93	27	88	71	30	75	20	76	74	81	5.75	−1.8	14	----	n.	----	----	----	10	16	5	----	.0	.0
Pensacola	56	149	185	29.96	30.02	+.04	81.0	+.1	94	27	87	68	1	75	19	75	74	82	6.81	−1.2	13	6,993	se.	28	n.	10	15	13	3	3.9	.0	.0
Anniston	741	9	----	----	----	----	80.0	+3.6	98	18	91	55	31	69	30	----	----	----	5.31	+1.3	10	----	s.	----	----	----	14	11	6	----	.0	.0
Birmingham	700	11	48	29.27	30.02	+.03	80.4	+1.2	97	27	90	60	1	70	26	72	70	79	4.00	−.3	16	4,051	s.	21	ne.	20	11	15	5	4.6	.0	.0
Mobile	57	86	105	29.94	30.00	+.02	82.2	+1.2	95	5	90	66	1	74	25	75	73	79	6.29	−.6	12	4,530	s.	27	n.	5	9	16	6	4.7	.0	.0
Montgomery	218	92	105	29.79	30.03	+.04	82.0	+1.2	96	25	91	64	1	73	25	74	71	76	3.43	−.8	8	4,184	e.	30	ne.	17	14	12	5	4.3	.0	.0
Meridian	375	67	92	29.62	30.00	+.02	80.9	+1.4	96	28	91	60	31	71	28	73	71	78	4.60	+.1	14	3,480	e.	25	ne.	17	17	10	4	3.6	.0	.0
Vicksburg	247	65	73	29.74	30.00	+.02	83.4	+2.6	99	18	93	64	1	74	24	73	70	72	.72	−2.7	7	4,228	s.	23	e.	17	16	9	6	3.9	.0	.0
New Orleans	53	76	84	29.95	30.00	+.02	83.2	+1.0	95	12	90	70	1	76	19	76	74	79	7.48	+1.7	12	3,981	se.	16	e.	8	5	21	5	5.8	.0	.0
West Gulf States							85.0	+3.1										63	2.07	−1.5										4.1		
Shreveport	249	92	227	29.71	29.97	.00	86.6	+4.6	109	10	97	64	1	76	30	73	68	62	.39	−2.3	4	6,212	s.	25	s.	18	15	11	5	4.0	.0	.0
Bentonville	1,303	12	38	28.64	29.96	−.02	85.8	+9.3	110	10	99	55	1	73	41	----	----	----	.08	−4.1	2	4,738	s.	16	ne.	16	10	18	3	----	.0	.0
Fort Smith	457	79	94	29.46	29.96	−.05	88.4	+7.9	113	10	101	64	1	76	34	70	61	46	.50	−2.8	2	5,316	e.	49	se.	17	13	18	0	3.8	.0	.0
Little Rock	357	94	102	29.60	29.97	−.01	84.9	+5.1	110	10	95	65	31	74	34	73	68	63	.27	−3.5	2	5,545	s.	18	sw.	25	21	7	3	3.0	.0	.0
Austin	605	136	148	29.33	29.96	----	84.0	+.2	105	11	95	64	2	74	28	73	70	68	2.90	+.8	7	4,451	se.	23	s.	31	16	13	2	3.5	.0	.0
Brownsville	57	88	96	29.85	29.91	----	82.9	−1.0	96	10	90	70	1	75	20	76	74	83	6.70	+4.2	9	6,459	e.	24	ne.	29	9	14	8	5.5	.0	.0
Corpus Christi	20	11	78	29.93	29.95	+.02	83.6	+1.1	95	10	90	72	1	78	18	76	74	79	3.23	+1.0	7	7,409	se.	26	e.	29	14	12	5	4.7	.0	.0
Dallas	512	220	227	29.40	29.93	----	87.0	----	110	10	97	67	1	77	30	71	64	52	.26	−2.5	1	6,934	se.	40	ne.	23	19	10	2	2.6	.0	.0
Fort Worth	679	92	110	29.26	29.96	+.02	87.6	+4.6	112	11	99	63	1	76	33	----	----	----	.23	−2.4	1	6,517	s.	31	se.	23	25	5	1	1.8	.0	.0
Galveston	54	106	114	29.92	29.98	+.02	84.0	+1.0	94	9	88	71	3	80	15	76	74	76	2.52	−1.8	7	6,658	s.	25	s.	11	14	12	5	4.2	.0	.0
Houston	138	202	314	29.84	29.98	----	83.6	+.4	99	10	92	70	2	76	23	----	----	----	2.95	−1.2	8	6,605	s.	34	ne.	23	8	16	7	5.4	.0	.0
Palestine	510	64	72	29.46	29.97	.00	84.2	+2.4	104	10	95	65	1	73	31	73	69	69	.63	−1.5	5	4,344	s.	25	ne.	9	14	13	4	4.0	.0	.0
Port Arthur	34	58	66	29.94	29.98	----	83.8	----	97	7	91	70	1	76	20	75	74	77	5.60	−.4	12	4,551	s.	21	ne.	17	9	17	5	5.1	.0	.0
San Antonio	693	242	301	29.24	29.94	+.01	83.8	+.3	106	11	94	69	1	73	27	72	67	68	2.73	+.3	5	6,847	e.	37	e.	24	8	18	5	5.0	.0	.0

See footnotes at end of table.

TABLE 1.—*Climatological data for Weather Bureau stations, August 1936*—Continued

District and station	Elevation of instruments: Barometer above sea level	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to means of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max. + mean min. ÷ 2	Temperature: Departure from normal	Temperature: Maximum	Temperature: Date	Temperature: Mean maximum	Temperature: Minimum	Temperature: Date	Temperature: Mean minimum	Temperature: Greatest daily range	Mean wet thermometer	Mean temperature of the dew-point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with 0.01 inch, or more	Wind: Total movement	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	*Ft.*	*Ft.*	*In.*	*In.*	*In.*	° *F.*	° *F.*	° *F.*		° *F.*	° *F.*		° *F.*	° *F.*	° *F.*	° *F.*	%	*In.*	*In.*		*Miles*								0–10	*In.*	*In.*
Ohio Valley and Tennessee							**79.8**	**+4.9**										**66**	**2.62**	**−0.9**										**4.5**		
Chattanooga	762	71	214	29.24	30.05	+0.05	81.8	+4.3	103	18	92	61	1	72	31	71	67	69	3.70	−.3	8	4,532	w.	33	nw.	29	11	15	5	4.9	0.0	0.0
Knoxville	995	66	84	29.01	30.04	+.03	80.2	+4.0	99	20	91	57	31	70	30	71	68	73	1.97	−2.0	11	3,749	sw.	27	ne.	27	19	8	4	3.6	.0	.0
Memphis	399	78	86	29.56	29.98	.00	83.7	+4.3	101	18	92	62	1	75	24	72	67	63	.40	−3.0	2	5,052	sw.	17	n.	29	19	10	2	3.0	.0	.0
Nashville	546	168	188	29.46	30.03	+.03	81.8	+4.0	102	18	92	58	31	72	28	71	67	67	.59	−3.1	5	5,184	sw.	41	nw.	4	9	16	6	4.8	.0	.0
Lexington	989	6					81.5	+7.0	105	19	95	51	31	68	35				1.26	−2.2	9		sw.				20	10	1		.0	.0
Louisville	525	188	234	29.44	30.01	+.01	83.0	+6.0	101	19	93	59	31	73	30	70	64	59	2.21	−1.2	7	6,585	sw.	32	nw.	21	13	15	3	3.9	.0	.0
Evansville	431	76	116	29.53	29.99	.00	84.0	+6.6	104	19	94	62	31	74	26	70	65	58	.51	−2.8	3	6,053	s.	37	w.	10	17	11	3	4.0	.0	.0
Indianapolis	822	194	230	29.13	29.99	−.01	80.5	+6.8	101	22	91	58	30	70	31	67	60	54	2.49	−.8	10	6,987	sw.	33	s.	26	13	14	4	4.4	.0	.0
Terre Haute	575	63	149	29.36	29.96		82.2		104	18	94	57	31	70	35	69	63	57	2.26	−1.0	8	6,315	sw.	58	w.	28	19	11	1	2.8	.0	.0
Cincinnati	627	11	51	29.34	30.00	−.01	80.1	+6.5	103	22	91	58	31	69	30	68	63	65	4.32	+.9	11	4,585	sw.	28	sw.	4	9	15	7	5.3	.0	.0
Columbus	822	90	210	29.14	30.00	−.01	77.8	+4.8	101	19	88	55	31	68	31	67	63	64	4.94	+1.7	16	5,707	s.	43	nw.	25	10	17	4	4.9	.0	.0
Dayton	900	58	153	29.07	29.99		79.2	+5.8	102	19	90	57	31	69	30				4.50	+1.2	14	5,514	sw.	38	w.	28	12	14	5	4.6	.0	.0
Elkins	1,947	59	78	28.07	30.05	+.03	71.8	+2.7	95	22	84	48	1	60	35	65	63	83	3.44	−.4	12	3,291	se.	25	nw.	25	8	12	11	5.9	.0	.0
Parkersburg	637	77	84	29.40	30.04	+.03	77.7	+3.8	112	21	88	54	1	67	31	68	65	71	2.77	−.7	9	3,893	se.	27	nw.	19	11	10	10	5.4	.0	.0
Pittsburgh [1]	842	164	410	28.68	30.00	−.01	74.6	+1.7	98	21	85	51	31	64	28	66	62	73	3.97	+.7	11	6,740	sw.	43	nw.	29	7	15	9	6.0	.0	.0
Lower Lake Region							**71.8**	**+2.2**										**68**	**2.42**	**−0.6**										**5.3**		
Buffalo	768	243	280	29.18	29.99	.00	69.7	+1.1	87	19	77	53	27	62	27	62	57	67	1.94	−1.1	10	9,665	sw.	43	sw.	23	10	13	8	5.0	.0	.0
Canton	448	10	61	29.51	29.98		65.0	−2.8	87	3	76	41	26	54	36	59	55	73	4.77	+1.1	14	5,237	sw.	21	sw.	23	5	15	11	6.4	.0	.0
Ithaca	836	77	100	29.11	30.00		71.2	+2.6	96	3	84	43	18	58	41	62	58	70	2.71	−.7	14	5,131	nw.	27	n.	19	6	15	10	5.9	.0	.0
Oswego	335	71	85	29.62	29.99	.00	68.4	.0	93	3	77	51	18	60	27	62	58	74	3.53	+.9	10	5,789	n.	22	n.	17	5	12	14	6.5	.0	.0
Rochester	523	86	102	29.45	30.01	+.02	70.6	+1.4	94	3	80	51	18	61	33	60	55	61	1.25	−1.6	10	5,658	ne.	25	sw.	23	12	8	11	5.3	.0	.0
Syracuse	596	65	79	29.38	30.02	+.03	71.4	+2.6	95	3	82	50	26	60	32				2.44	−.4	14	4,738	s.	24	n.	10	6	15	10	6.1	.0	.0
Erie	714	130	166	29.24	29.99	−.02	72.7	+3.1	93	19	80	55	18	65	27	65	61	70	1.28	−2.0	12	8,415	n.	32	sw.	19	13	11	7	4.6	.0	.0
Cleveland	762	267	318	29.19	30.00	−.01	73.8	+3.8	94	22	81	56	30	67	21	65	61	67	2.92	+.2	10	9,112	s.	43	nw.	25	9	15	7	5.1	.0	.0
Sandusky	629	5	67	29.33	30.00	−.01	75.0	+3.2	102	22	84	55	31	66	30				1.83	−1.3	10	5,684	e.	30	w.	23	10	13	8	5.3	.0	.0
Toledo	628	79	87	29.34	30.01	+.01	75.0	+3.7	101	22	84	54	31	65	28	65	60	65	1.62	−1.2	7	6,137	w.	29	w.	19	16	10	5	3.8	.0	.0
Fort Wayne	857	69	84	29.09	29.99		76.2	+5.0	98	13	86	56	30	66	31	66	60	63	3.65	+.5	12	5,477	sw.	31	nw.	23	13	12	6	4.4	.0	.0
Detroit [1]	626	5	78	29.32	30.00	−.01	73.1	+2.8	101	22	84	52	5	62	34	64	59	65	1.07	−1.7	9	6,148	ne.	26	nw.	19	11	12	8	5.1	.0	.0
Upper Lake Region							**68.8**	**+2.5**										**72**	**3.64**	**+0.8**										**5.7**		
Alpena	609	13	89	29.35	30.01	+.01	65.8	+1.7	93	9	75	47	31	57	33	59	56	75	4.74	+1.9	13	7,677	nw.	34	nw.	9	10	11	10	5.3	.0	.0
Escanaba	612	54	60	29.34	30.00	+.01	64.3	.0	88	22	72	45	20	57	26	59	56	77	3.77	+.6	11	7,189	s.	32	n.	24	7	10	14	6.5	.0	.0
Grand Rapids	707	70	244	29.23	29.98	−.02	73.9	+4.2	98	22	85	55	31	63	35	63	58	65	3.91	+1.3	14	7,118	sw.	37	sw.	22	12	12	7	4.8	.0	.0
Lansing	878	5	90	29.07	29.99		71.0	+2.5	94	22	82	51	31	60	33	62	58	68	2.42	−.4	11	5,521	w.	22	w.	22	12	11	8	4.7	.0	.0
Ludington	637	5	54	29.30	29.99		68.8	+3.5	87	13	77	48	17	60	26	61			2.13	−.5	7		s.				15	10	6		.0	.0
Marquette	734	77	111	29.20	29.99	+.01	64.7	+.9	93	1	72	48	31	57	33	58	54	74	4.79	+2.1	14	7,041	nw.	29	se.	28	2	11	18	7.2	.0	.0
Sault Sainte Marie	614	11	52	29.32	30.00	+.01	63.1	+1.0	88	1	72	44	31	54	36	58	55	78	2.85	+.2	13	5,134	nw.	24	nw.	16	6	12	13	6.4	.0	.0
Chicago	673	7	131	29.27	29.99	−.01	75.0	+3.4	99	22	83	57	30	67	31	67	63	72	4.29	+1.1	15	6,855	s.	32	ne.	9	16	8	7	4.2	.0	.0
Green Bay	617	109	141	29.32	29.97	−.02	70.6	+2.9	92	2	80	52	31	61	33	62	57	69	3.28	+.1	14	7,416	s.	44	nw.	15	7	10	14	6.4	.0	.0
Milwaukee	681	97	221	29.26	29.98	−.02	72.8	+3.6	98	22	80	56	30	65	33	64	60	70	5.92	+3.3	14	8,947	e.	47	n.	9	10	13	8	4.9	.0	.0
Duluth	1,133	5	47	28.76	29.96	−.01	66.6	+4.0	93	7	75	52	31	58	33	58	54	71	1.93	−1.2	14	8,996	ne.	35	e.	24	6	10	15	6.5	.0	.0
North Dakota							**70.7**	**+4.6**										**56**	**1.02**	**−1.2**										**5.3**		
Moorhead, Minn.	940	50	58	28.95	29.94	−.02	71.6	+5.5	98	1	83	49	26	60	37	60	53	58	.96	−1.9	6	6,086	n.	21	sw.	7	3	13	15	6.8	.0	.0
Bismarck	1,674	8	57	28.18	29.93	−.01	72.6	+5.3	99	8	86	48	25	60	37	58	48	51	.62	−1.2	7	6,530	ne.	34	w.	17	15	10	6	4.8	.0	.0
Devils Lake	1,478	11	44	28.42	29.97	+.03	68.6	+3.8	99	7	82	39	26	55	39	57	50	61	1.48	−1.0	7	5,972	ne.	22	ne.	11	8	9	14	5.7	.0	.0
Grand Forks	833	12	67				70.0		100	7	83	41	30	57	42	58			.49		9		ne.	27	sw.	7	7	19	5		.0	.0
Williston	1,878	42	50	28.00	29.94	+.01	69.9	+3.8	103	10	82	48	29	58	38	56	47	53	1.01	−.5	8	5,353	se.	23	ne.	2	15	10	6	3.8	.0	.0
Upper Mississippi Valley							**79.3**	**+6.4**										**60**	**3.14**	**−0.1**										**4.2**		
Minneapolis	919	105	208	28.98	29.95		74.7	+4.8	103	15	85	53	29	65	36	62	55	58	3.48	+.4	7	7,310	n.	41	w.	15	10	11	10	5.5	.0	.0
La Crosse	714	11	48	29.18	29.94	−.04	74.8	+4.8	100	15	86	51	30	63	35	64	59	66	4.08	+.4	12	3,459	s.	16	n.	15	9	13	9	5.2	.0	.0
Madison	974	70	78	28.94	29.96	−.03	73.9	+4.1	101	18	84	55	29	63	44	65	60	68	5.97	+2.8	15	5,750	s.	30	ne.	25	12	12	7	4.9	.0	.0
Charles City	1,015	10	51	28.90	29.95	−.02	75.4	+6.3	98	18	88	50	30	63	35	65	59	63	7.52	+4.0	15	4,722	se.	21	se.	17	14	11	6	3.9	.0	.0
Davenport	606	66	161	29.31	29.92	−.06	80.0	+6.9	105	18	91	57	30	68	34	67	61	59	3.85	+.4	13	6,381	se.	30	ne.	9	14	12	5	4.1	.0	.0
Des Moines	861	5	99	29.24	29.92	−.05	80.4	+7.3	108	18	93	57	30	68	37	67	61	59	2.53	−1.0	13	6,019	se.	27	w.	25	11	14	6	4.5	.0	.0
Dubuque	700	60	79	29.22	29.95	−.03	76.8	+5.1	107	18	89	54	30	65	44	66	60	63	4.68	+1.4	15	4,225	s.	22	s.	22	13	12	6	4.5	.0	.0
Keokuk	614	64	78	29.29	29.93	−.05	83.4	+8.4	106	18	95	60	30	72	33	68	60	51	.78	−2.4	6	5,206	sw.	21	ne.	19	14	11	6	4.5	.0	.0
Cairo	358	87	93	29.60	29.97	−.05	83.4	+5.6	101	17	93	63	31	74	24	71	67	64	.12	−2.9	3	5,430	s.	18	n.	5	15	13	3	4.2	.0	.0
Peoria	609	11	45	29.32	29.98	−.01	80.3	+7.8	106	18	93	54	30	68	35	68	63	64	2.27	−.8	10	4,396	se.	28	nw.	25	20	9	2	2.6	.0	.0
Springfield, Ill.	636	5	191	29.29	29.95	−.01	82.5	+8.0	106	18	94	60	30	71	30	69	63	57	1.61	−1.6	7	7,790	s.	24	nw.	15	16	13	2	3.9	.0	.0
St. Louis	568	179	303	29.36	29.95	−.04	85.6	+8.1	106	18	96	66	1	75	31	69	62	50	.85	−2.1	5	8,641	sw.	48	s.	15	19	9	3	2.9	.0	.0
Missouri Valley							**83.1**	**+8.8**										**50**	**1.38**	**−2.0**										**3.8**		
Columbia, Mo.	784	6	84	29.13	29.90	−.07	85.1	+9.5	108	15	97	56	30	73	32				1.34	−2.3	6	5,604	s.	24	nw.	16	17	10	4	3.5	.0	.0
Kansas City [1]	750	32	45	29.13	29.90	−.07	87.0	+10.4	113	14	100	57	30	74	43	69	60	47	.25	−3.8	4	6,775	sw.	34	sw.	14	18	8	5	3.6	.0	.0
St. Joseph	967	11	49	28.90	29.90		85.6		110	13	98	59	30	73	39	68	60	51	1.02	−2.5	9	5,662	s.	21	s.	17	17	9	5	3.5	.0	.0
Springfield, Mo.	1,324	98	104	28.59	29.96	−.01	84.4	+8.7	105	16	95	63	1	74	30	67	59	48	.78	−3.3	8	6,936	s.	24	nw.	28	17	12	2	3.3	.0	.0
Iola	984	11	50				87.2	+10.1	110	9	101	56	30	73	40				.74	−2.8	4		se.				17	12	2		.0	.0
Topeka	987	65	87				87.4	+11.2	113	14	101	60	1	74	41				.57	−3.5	5	6,544	s.	25	nw.	4	20	6	5	3.1	.0	.0
Lincoln	1,189	11	81	28.66	29.88	−.07	83.2	+8.8	110	18	97	57	30	70	35	66	56	49	1.63	−1.9	12	6,956	s.	36	nw.	27	14	10	7	4.3	.0	.0
Omaha	1,105	170	200	28.88	29.90	−.06	81.8	+7.4	110	18	95	56	30	69	34	67	59	55	2.43	−.6	9	6,835	se.	46	w.	15	16	9	6	4.2	.0	.0
Valentine	2,598	47	54	27.28	29.93	−.01	77.8	+6.1	107	24	92	46	29	64	41	61	51	49	1.65	−.5	9	6,688	sw.	32	sw.	14	16	11	4	3.6	.0	.0
Sioux City	1,138	64	106	28.71	29.88	−.07	81.0	+9.0	108	24	93	55	30	69	34	65	56	50	1.66	−1.5	6	7,053	s.	35	nw.	27	12	13	6	4.3	.0	.0
Huron	1,307	59	74	28.55	29.91	−.04	76.2	+6.8	103	1	89	50	5	64	38	62	53	53	3.08	+.6	10	7,049	se.	39	ne.	19	14	14	3	3.9	.0	.0
Northern Slope							**70.2**	**+4.1**										**50**	**0.85**	**−0.3**										**4.2**		
Havre	2,505	11	67	27.37	29.96	+.05	70.4	+5.0	97	9	84	45	28	56	42	55	45	50	1.50	+.3	9	5,665	e.	26	w.	6	13	15	3	3.8	.0	.0
Helena	4,124	85	111	25.86	29.97	+.03	67.7	+2.7	91	9	81	44	25	54	38	53	44	49	.69	−.1	5	5,632	sw.	30	nw.	24	13	8	10	5.0	.0	.0
Missoula	3,263	80	91				70.4	+4.8	95	16	86	41	25	54	45				.39	−.5	5	5,065	se.	38	s.	12	14	12	5	3.9	.0	.0
Kalispell	2,973	48	56		29.93		66.5	+3.7	91	9	82	39	25	51	43			48	.47	−.4	6	4,786	nw.	19	w.	14	16	14	1		.0	.0
Miles City	2,371	48	55	27.46	29.94	+.01	74.6	+3.1	102	9	87	47	5	62	39	57	46	44	.39	−.7	8	4,518	n.	30	w.	14	12	15	4	4.0	.0	.0
Rapid City	3,259	50	58	26.64	29.96	+.03	75.0	+5.5	101	10	88	49	30	62	44	59	47	44	.70	−1.0	7	5,660	w.	25	n.	17	16	9	6	3.9	.0	.0
Cheyenne [1]	6,094	50	71	24.08	29.96	+.04	68.5	+2.9	91	24	83	39	28	54	39	54	47	55	1.10	−.4	10	7,347	nw.	28	w.	17	11	15	5	4.8	.0	.0
Lander	5,372	60	68	24.74	29.97	+.05	67.8	+2.3	96	8	83	40	28	52	44	53	44	50	1.09	+.6	6	7,053	sw.	30	sw.	14	14	13	4	4.1	.0	.0
Sheridan	3,790	10	47	26.13	29.96		71.5		101	9	88	40	28	55	51	56	46	50	.19	−.7	4	3,644	nw.	37	se.	3	18	9	4	3.8	.0	.0
Yellowstone Park	6,241	12	46	24.00	30.05	+.12	61.9	+2.8	87	8	76	34	28	48	43	49	41	55	1.62	+.6	11	5,682	sw.	27	n.	18	10	10	11	5.2	.0	.0
North Platte	2,821	11	51	27.06	29.91	−.03	78.7	+7.9	108	11	93	49	29	64	41	63	55	56	1.23	−1.2	5	4,754	s.	22	n.	27	20	7	4	3.3	.0	.0

See footnotes at end of table.

TABLE 1.—*Climatological data for Weather Bureau stations, August 1936*—Continued

District and station	Elevation of instruments: Barometer above sea level	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to means of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max. + mean min. ÷ 2	Temperature: Departure from normal	Temperature: Maximum	Temperature: Date	Temperature: Mean maximum	Temperature: Minimum	Temperature: Date	Temperature: Mean minimum	Temperature: Greatest daily range	Mean wet thermometer	Mean temperature of the dew-point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with 0.01 inch, or more	Wind: Total movement	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	Ft.	Ft.	In.	In.	In.	° F.	° F.	° F.		° F.	° F.		° F.	° F.	° F.	° F.	%	In.	In.		Miles								0-10	In.	In.
Middle Slope							**8.25**	**+6.6**										**45**	**1.41**	**-1.1**										**3.3**		
Denver	5,292	106	113	24.83	29.97	+0.05	73.6	+2.9	97	26	85	57	4	62	33	58	49	52	3.22	+1.8	11	5,530	s.	24	s.	26	12	12	7	4.7	0.0	0.0
Pueblo	4,685	80	86	25.37	29.95	+.04	75.0	+2.3	98	26	88	56	23	62	41	60	52	56	2.21	+.4	10	4,853	nw.	28	s.	14	14	12	5	4.2	.0	.0
Concordia	1,392	50	58	28.48	29.90	-.05	85.2	+8.7	116	12	99	58	30	71	45	66	55	44	1.82	-1.1	10	5,769	s.	26	w.	19	16	11	4	3.6	.0	.0
Dodge City	2,509	10	86	27.39	29.91	-.02	83.6	+5.9	109	13	98	58	29	69	37	63	51	41	.98	-1.7	4	7,817	s.	27	se.	14	21	7	3	2.5	.0	.0
Wichita	1,358	85	93	28.50	29.88	-.07	89.0	+10.7	114	12	101	61	29	77	32	66	52	35	.04	-3.1	2	8,180	sw.	29	sw.	18	23	6	2	2.3	.0	.0
Oklahoma City	1,214	10	47	28.67	29.91	-.03	88.7	+9.0	113	11	101	64	30	76	31	68	58	43	.17	-2.7	2	6,601	s.	18	ne.	23	25	4	2	2.5	.0	.0
Southern Slope							**82.8**	**+3.1**										**48**	**0.73**	**-1.6**										**2.9**		
Abilene	1,738	10	52	28.17	29.92	.00	86.8	+4.8	110	11	100	60	1	74	38	67	58	45	.12	-2.1	1	6,557	s.	34	s.	10	23	6	2	2.0	.0	.0
Amarillo	3,676	10	49	26.32	29.94	+.02	81.9	+6.2	103	12	95	60	29	69	32	62	50	40	1.39	-1.7	5	6,302	s.	27	se.	19	23	6	2	2.7	.0	.0
Del Rio	960	63	71	28.93	29.89	-.01	84.0	-.2	104	11	94	66	2	74	28	71	65	60	1.20	-.5	5	6,875	se.	26	se.	30	16	11	4	3.9	.0	.0
Roswell	3,566	75	85	26.40	29.92	+.04	78.3	+1.7	101	13	91	60	9	65	37	62	52	47	.22	-1.9	3	6,064	s.	27	ne.	28	21	7	3	2.9	.0	.0
Southern Plateau							**79.2**	**+2.2**										**52**	**0.75**	**-0.4**										**3.1**		
El Paso	3,778	82	101	26.19	29.87	+.03	80.8	+1.6	99	13	92	65	19	70	29	63	54	47	1.94	+.2	10	5,437	e.	32	se.	17	21	8	2	3.0	.0	.0
Albuquerque	4,972	5	39	25.11	29.86	----	76.4	+2.5	99	25	91	55	31	61	41	59	49	50	.62	-.6	4	6,140	n.	38	nw.	6	18	7	6	3.7	.0	.0
Santa Fe	7,013	38	53	23.40	29.90	+.01	69.8	+2.4	92	25	82	52	21	58	35	55	48	55	1.36	-.9	9	4,001	e.	24	n.	6	8	17	6	4.7	.0	.0
Flagstaff	6,907	10	59	23.47	29.89	+.05	65.2	+2.4	86	16	79	41	22	65	42	----	----	71	2.70	----	16	4,910	nw.	22	nw.	25	2	15	14	----	.0	.0
Phoenix	1,108	10	107	28.67	29.78	-.01	91.1	+2.6	110	14	103	74	22	79	34	71	61	44	.32	-.6	5	4,300	e.	38	sw.	8	21	10	0	2.8	.0	.0
Yuma	141	9	54	29.63	29.77	+.01	93.0	+2.6	114	14	106	70	22	80	40	74	66	47	.11	-.4	2	4,128	s.	30	se.	15	25	6	0	1.5	.0	.0
Independence	3,957	5	26	25.95	29.90	+.09	77.2	+1.1	99	3	94	52	20	60	43	56	----	----	.14	.0	2	----	s.	----	----	----	21	7	3	----	.0	.0
Middle Plateau							**73.4**	**+1.9**										**41**	**0.93**	**+0.2**										**3.0**		
Reno	4,527	61	76	25.49	29.80	+.05	71.4	+2.7	95	1	88	44	24	55	44	52	38	36	.48	+.3	5	4,773	sw.	26	ne.	4	24	3	4	2.3	.0	.0
Tonopah	6,090	12	20	----	----	----	73.9	----	90	15	85	56	11	62	29	53	36	30	.15	----	2	----	se.	----	----	----	----	----	----	----	----	----
Winnemucca	4,344	18	56	25.62	29.92	+.04	72.3	+3.0	97	8	91	41	25	53	49	53	38	37	.23	.0	5	5,144	sw.	25	se.	4	21	6	4	2.8	.0	.0
Modena	5,473	10	43	24.68	29.89	+.03	70.2	+1.0	91	24	85	43	22	55	43	56	46	51	2.13	+.8	10	6,922	sw.	33	nw.	1	17	11	3	3.4	.0	.0
Salt Lake City [1]	4,240	32	46	25.74	29.90	-.01	75.5	+1.0	100	8	90	48	28	61	40	59	48	47	.67	-.2	8	7,160	se.	43	sw.	10	19	11	1	2.6	.0	.0
Grand Junction	4,602	60	68	25.43	29.94	+.04	77.4	+2.0	98	15	90	55	22	65	32	59	49	45	1.13	.0	11	5,058	se.	21	se.	19	14	14	3	3.7	.0	.0
Northern Plateau							**72.6**	**+3.2**										**39**	**0.44**	**0.0**										**2.7**		
Baker	3,471	48	53	26.46	29.97	+.02	68.0	+3.4	94	15	85	39	25	51	45	51	37	38	.08	-.4	2	4,315	n.	17	sw.	16	22	4	5	2.8	.0	.0
Boise	2,739	79	87	27.12	29.91	-.02	75.0	+3.2	100	16	90	48	27	60	39	57	46	41	.38	+.2	4	3,731	se.	25	sw.	2	19	9	3	2.8	.0	.0
Pocatello	4,477	60	68	25.50	29.92	.00	71.8	+2.2	95	7	86	44	25	58	43	55	43	43	1.92	+1.2	9	5,877	se.	32	sw.	13	18	8	5	3.3	.0	.0
Spokane	1,929	101	110	27.93	29.93	-.02	71.0	+2.9	98	5	85	45	26	57	39	53	39	39	.23	-.4	3	4,488	s.	19	nw.	25	20	9	2	2.7	.0	.0
Walla Walla	991	57	65	28.88	29.93	-.03	75.6	+2.9	103	5	88	55	26	63	39	57	42	34	.01	-.5	1	4,306	w.	15	w.	24	22	7	2	2.2	.0	.0
Yakima	1,076	58	67	28.80	29.94	----	73.9	+4.4	100	5	88	49	23	60	37	57	43	38	T	-.2	0	5,199	nw.	24	nw.	29	19	12	0	2.2	.0	.0
North Pacific Coast Region							**64.6**	**+2.4**										**70**	**0.74**	**-0.1**										**4.6**		
North Head	211	11	56	29.85	30.07	+.04	60.6	+3.0	78	27	65	52	20	56	24	58	57	90	.83	-.2	4	8,365	nw.	34	s.	31	7	10	14	6.5	.0	.0
Seattle	125	90	321	29.89	30.02	+.02	66.4	+3.3	89	28	76	53	31	57	31	58	53	67	1.00	+.3	3	5,205	n.	24	se.	31	17	6	8	4.2	.0	.0
Tatoosh Island	86	10	54	29.96	30.05	+.05	57.4	+2.1	68	28	62	49	27	53	16	56	54	91	2.52	+.5	4	7,009	s.	34	e.	28	3	12	16	7.0	.0	.0
Medford	1,329	29	58	28.55	29.93	----	71.8	----	101	4	90	46	26	54	47	58	47	51	.00	-.2	0	----	w.	----	----	----	26	4	1	----	.0	.0
Portland, Oreg.	153	68	106	29.85	30.01	.00	69.5	+2.8	97	28	80	52	30	59	34	60	54	62	.07	-.6	3	4,581	nw.	15	nw.	4	17	10	4	3.5	.0	.0
Roseburg	510	45	76	29.46	30.00	.00	69.0	+1.0	97	27	85	46	30	53	48	58	50	58	.00	-.3	0	3,682	n.	17	n.	25	22	8	1	1.7	.0	.0
Middle Pacific Coast Region							**69.0**	**+1.8**										**62**	**T**	**0.0**										**3.2**		
Eureka	62	73	89	29.95	30.02	+.02	56.5	+.5	65	22	61	48	16	52	15	54	53	89	T	-.2	0	4,642	nw.	18	n.	24	5	15	11	5.9	.0	.0
Redding	722	20	34	----	----	----	83.2	+2.7	107	5	97	58	21	70	32	60	40	26	T	.0	0	6,021	nw.	18	w.	23	26	3	2	1.3	.0	.0
Sacramento	69	92	115	29.77	29.84	-.01	77.0	+4.1	105	5	94	52	22	60	42	60	49	46	.00	.0	0	5,121	s.	20	s.	9	28	2	1	.7	.0	.0
San Francisco	155	112	132	29.74	29.91	-.01	59.3	+.2	78	8	65	49	6	54	23	55	53	85	.02	.0	1	7,336	w.	22	w.	1	10	14	7	4.8	.0	.0
South Pacific Coast Region							**76.0**	**+2.5**										**62**	**0.10**	**+0.1**										**2.5**		
Fresno	327	97	105	29.48	29.82	.00	83.1	+2.4	107	7	99	57	22	67	38	62	46	33	T	.0	0	5,081	nw.	16	nw.	10	27	2	2	1.2	.0	.0
Los Angeles	338	159	191	29.52	29.88	.00	73.4	+2.3	93	8	83	60	21	64	25	64	61	72	.02	.0	1	4,085	sw.	25	se.	8	25	5	1	2.7	.0	.0
San Diego	87	62	70	29.78	29.87	-.02	71.4	+2.7	94	8	76	63	22	66	28	66	64	80	.28	+.2	2	5,025	nw.	26	s.	8	19	9	3	3.7	.0	.0
West Indies																																
San Juan, P. R.	82	9	54	29.87	29.95	----	80.2	-.3	87	11	84	72	24	76	14	----	----	----	9.30	+3.3	25	8,315	e.	31	e.	21	7	17	7	5.1	.0	.0
Panama Canal																																
Balboa Heights	118	6	92	----	[2]29.80	-.03	80.4	-.8	91	8	86	72	4	74	16	----	----	[3]87	6.14	-1.7	17	3,816	nw.	19	n.	9	0	11	20	7.9	.0	.0
Cristobal	36	6	97	----	[2]29.82	-.02	81.4	+1.2	90	28	86	74	4	77	15	77	75	[3]85	13.78	-1.4	27	5,005	w.	30	n.	17	0	9	22	8.3	.0	.0
Alaska																																
Fairbanks	454	11	87	[3]29.43	[3]29.94	----	57.7	----	83	12	69	34	28	47	38	52	47	73	2.12	----	14	4,327	s.	23	se.	31	6	12	13	6.5	.0	.0
Juneau	80	96	116	[3]29.94	[3]30.03	----	57.8	----	76	3	65	45	11	51	26	54	51	79	2.76	----	17	3,500	s.	21	se.	29	8	4	19	7.0	.0	.0
Hawaiian Islands																																
Honolulu	38	86	100	[3]29.95	[3]29.99	----	78.4	.0	84	12	82	71	6	74	11	70	67	69	.48	-.8	14	8,068	e.	30	e.	21	13	16	2	4.1	.0	.0

[1] Observations taken at airport.
[2] Observations taken bihourly.
[3] Pressure not reduced to mean of 24 hours.

TABLE 2.—*Data furnished by the Canadian Meteorological Service, August 1936*

Station	Altitude above mean sea level, Jan. 1, 1919	Pressure: Station reduced to mean of 24 hours	Pressure: Sea level reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max.+mean min.÷2	Temperature of the air: Departure from normal	Temperature of the air: Mean maximum	Temperature of the air: Mean minimum	Temperature of the air: Highest	Temperature of the air: Lowest	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Total snowfall
	Feet	*Inches*	*Inches*	*Inches*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	*Inches*	*Inches*	*Inches*
Cape Race, Newfoundland	99				55.2		63.2	47.2	71	42	6.21		0.0
Sydney, Cape Breton Island	48	29.90	29.95	0.00	63.3	0.0	73.2	53.5	82	41	6.53	+2.91	.0
Halifax, Nova Scotia	88	29.73	29.83	−.13	63.4	−.2	71.1	55.7	82	46	6.47	+2.12	.0
Yarmouth, Nova Scotia	65	29.88	29.95	−.02	61.0	+.8	69.0	53.0	75	44	3.65	+.03	.0
Charlottetown, Prince Edward Island	38	29.87	29.91	−.03	63.4	−.9	71.1	55.7	81	46	2.78	−.96	.0
Chatham, New Brunswick	28	29.83	29.86	−.07	61.7	−1.5	72.5	51.0	84	37	2.69	−1.35	.0
Father Point, Quebec	20	29.89	29.91	.00	54.9	−.7	62.0	47.8	78	42	1.64	−1.41	.0
Quebec, Quebec	296												
Doucet, Quebec	1,236				55.0		67.2	42.8	82	26	2.78		.0
Montreal, Quebec	187	29.78	29.98	+.03	65.5	−.9	72.5	58.4	84	51	4.21	+.64	.0
Ottawa, Ontario	236												
Kingston, Ontario	285	29.57	29.87	−.11	67.1	+.1	75.0	59.2	85	48	2.10	−.28	.0
Toronto, Ontario	379	29.59	29.98	−.01	68.9	+2.9	79.0	58.9	97	50	1.75	−1.01	.0
Cochrane, Ontario	930				60.1		70.8	49.4	82	29	1.38		.0
White River, Ontario	1,244	28.66	29.95	−.01	58.3	+1.9	72.0	44.7	84	27	3.14	−.16	.0
London, Ontario	808				68.8		81.9	55.8	93	43	1.70		.0
Southampton, Ontario	656												
Parry Sound, Ontario	688	29.30	29.98	.00	64.5	+1.0	74.4	54.5	89	46	2.98	+.26	.0
Port Arthur, Ontario	644	29.35	30.06	+.10	59.6	+.1	69.5	49.7	83	34	4.37	+1.62	.0
Winnipeg, Manitoba	760	29.15	29.96	+.02	66.4	+3.0	79.3	53.5	102	42	.50	−2.17	.0
Minnedosa, Manitoba	1,690												
Le Pas, Manitoba	860				61.7		73.8	49.7	85	36	2.54		.0
Qu'Appelle, Saskatchewan	2,115												
Moose Jaw, Saskatchewan	1,759												
Swift Current, Saskatchewan	2,392												
Medicine Hat, Alberta	2,365												
Calgary, Alberta	3,540												
Banff, Alberta	4,521												
Prince Albert, Saskatchewan	1,450	28.44	29.99	+.07	62.8	+3.9	75.3	50.3	88	41	.94	−1.21	.0
Battleford, Saskatchewan	1,592												
Edmonton, Alberta	2,150	27.71	29.96	+.04	60.8	+2.0	73.4	48.3	84	41	1.80	−.33	.0
Kamloops, British Columbia	1,262												
Victoria, British Columbia	230												
Barkerville, British Columbia	4,180												
Estevan Point, British Columbia	20				58.3		63.9	52.7	67	48	5.46		.0
Prince Rupert, British Columbia	170												
St. Georges, Bermuda	158		30.10	.00	81.3	+1.7	87.3	75.2	92	71	5.40	−.56	.0
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Kingston, Ontario	285	29.56	29.86	−.11	69.1	+.9	77.9	60.3	96	50	2.06	−.83	.0
Southampton, Ontario	656	29.25	29.96	−.01	65.6	+.9	76.6	54.7	92	39	.56	−1.42	.0
Parry Sound, Ontario	688	29.22	29.90	−.06	68.0	+2.0	78.2	57.8	96	44	1.40	−1.22	.0
Minnedosa, Manitoba	1,690	28.13	29.89	−.04	72.5	+10.3	86.9	58.2	107	41	.51	−2.09	.0
Moose Jaw, Saskatchewan	1,759				74.8		89.4	60.2	102	44	1.03		.0
Medicine Hat, Alberta	2,365	27.41	29.82	−.08	77.2	+9.4	92.5	61.9	106	47	.10	−1.99	.0
Prince Albert, Saskatchewan	1,450	28.38	29.92	+.01	68.7	+6.8	80.0	57.4	93	47	.56	−1.49	.0
Edmonton, Alberta	2,150	27.62	29.85	−.05	65.2	+4.6	78.9	51.5	93	38	1.98	−1.05	.0

TABLE 3.—*Severe local storms, August 1936*

[Compiled by Mary O. Souder from reports submitted by Weather Bureau officials]

The table herewith contains such data as have been received concerning severe local storms that occurred during the month. A revised list of tornadoes will appear in the Annual Report of the Chief of Bureau]

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Ada and Canyon Counties, Idaho.	2	4:30 - 5:30 p. m.			$2,000	Wind and dust	Air filled with blowing dust and sand greatly reduced visibility; electric and telephone wires broken by fallen trees.
Between Denver and Colorado Springs, Colo.	2	5-6 p. m				Heavy rains	Colorado Springs highway flooded temporarily halting traffic; section of the Mount Vernon Canon road washed out.
Walsenburg, Colo.[2]	3	P. m.		1	185,000	Heavy rain and flood.	60 houses demolished; baseball park, several streets and railroad bridge washed out. The greatest loss was in riprap work torn out along the river.
Unionville, Bristol, Suffield, Stonington and Cromwell, Conn.[2]	4	3:14 - 5:40 p. m.			64,000	Thundersquall	Several barns and houses, 11 cows and other valuable livestock burned; suspension of telephone and electric service due to uprooted trees falling across wires; several tobacco sheds damaged; man injured by lightning.
Fairlee, Vt, and vicinity	[2] 4	P. m.		0		Tornado and hail	Telephone and electric poles leveled; trees uprooted and small sheds wrecked. Funnel-shaped cloud accompanied by hail that hit crops heavily.
Pittsylvania County, Va	6	2-4 p. m	[1] 2		40,000	Thundersquall and hail.	Loss mostly to corn and tobacco crop.
Pueblo, Colo.[2]	6	P. m.			41,500	Heavy rain	The Fountain River overflowed its banks with considerable loss to the Colorado State Hospital, it being necessary to remove 200 patients to buildings on higher ground when their regular quarters were threatened.
San Diego, Calif, west of	8	3 p. m.				Tropical disturbance.	As a result, new maximum wind and temperature records for August were recorded. Damage limited to tender plants whipped by the wind.
Tucson and Phoenix, Ariz., and vicinity.	8				15,000	Wind and rain	Storm struck the central and southeastern parts of the State. Near Tucson railroad tracks were washed out, highways blocked, and railway, bus and airline schedules disrupted. In Phoenix roofs were swept away and trees uprooted. 2 persons injured when their home was demolished.

[1] Miles instead of yards.

[2] From press reports.

TABLE 3.—*Severe local storms, August 1936*—Continued

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Decatur, Ill.	9				$7,500	Wind	Damage to property; loss to crops.
Milledgeville, Ill.	9				5,000	Electrical	2 barns destroyed.
Menominee, Mich.	9					Heavy hail	Property damaged.
Dunbarton, Wis., vicinity of	9				7,000	Wind	Several silos, barns, and windmills blown down and buildings unroofed.
Milwaukee, Wis., and vicinity	9			2	30,000	Thundersquall	Trees and poles blown down; man drowned in Lake Michigan when a sailboat overturned; a railway switchman killed by lightning.
Beason, Ill	10				5,000	Wind	Property damaged.
Clinton, Ill.	10				600	Hail	Damage to greenhouses.
Effingham, Ill.	10				1,000	Wind	Property damaged.
Vanderbilt, Boyne Falls, and Grand Rapids, Mich.[2]	10					Wind, rain, and hail.	Communication lines disrupted, trees blown down, and buildings damaged.
Oswego, N. Y.	10	11 - 11:45 a. m.				Severe thundersquall.	Cellars flooded in the business district in the southeast section of the city; trees uprooted and wires blown down.
Gladewater, Tex.[2]	10		[1] 2		100,000	Wind	No details.
Filer Idaho, vicinity of	11	2-3 p. m.	880		40,000	Hail	Loss mostly to crops; path 5 miles long.
Denver, Colo., and vicinity [2]	12	P. m.		1		Heavy rain, hail, electrical.	A person electrocuted by fallen power line; traffic disrupted; basements flooded; some damage by lightning; many roofs and gardens damaged by heavy hail.
Grant and Belmond Townships, Iowa.	13	12:30 a. m.	[1] 2		16,500	Wind, hail, electrical.	Corn blown down; some damage to crops by hail; barn destroyed by fire.
Freeport, Ill., and vicinity	13				12,500	Electrical	Property damaged.
Burlingame, Kans., vicinity of	14	4 p. m.	67	0		Tornado	Small damage to telephone and power lines; path 4 miles long.
Monticello, Kans	14	6 p. m.	880	0	5,000	do	Damage over a path 2 miles long.
Osage and Douglas Counties, Kans.	14	4:15 p. m.	[1] 1		2,800	Wind	Storm extended from the vicinity of Overbrook to beyond Worden; farm buildings, telephone and power lines damaged; path 13 miles long.
Major, Amsterdam, and Avery Townships, Iowa.	15	3:30 p. m.	[1] 5		125,000	Wind, rain, and hail.	Damage to buildings $75,000; crop loss $50,000; path 25 miles long.
Springfield, Ill.	15	P. m.				Thundersquall	Considerable damage at State fair grounds to tents, etc., and to trees; windows broken.
Minneapolis, Minn	15	do				Thundersquall and severe dust.	Property damaged.
Cortland, N. Y., and vicinity	15					Thundersquall	Several barns and a house burned; silos wrecked; much damage to telephone and power lines.
Polk County, Wis	15				50,000	Wind	Trees uprooted; property damaged.
Bedford County, Wis.							
Bedford County, Va	15-16	P. m.		1	10,000	Thunderstorms	A storm on the 15th, another on the 16th. Several buildings and farm animals struck by lightning.
Mount Carroll, Ill.	16				2,800	Electrical	Barn and contents destroyed.
Tupelo, Miss.	17	5 p. m.			5,000	Thundersqualls	Property damaged.
Saltillo, Miss., and vicinity	17	7 p. m.			1,500	do	Damage to property.
Grenada County, Miss	17	10 p. m.			2,000	Wind	No details.
Phoenix, Ariz	17	P. m.			5,000	Wind and rain	A near-cloudburst northeast of the city overtaxed canal banks and inundated citrus land, tons of valuable topsoil being washed away; awnings ripped from houses; windows broken; trees uprooted; light and power service disrupted and floors and yards flooded.
Guilford, Conn.[2]	17	do			100,000	do	Trees blown down blocking all highways leading to shore resorts. At least 25 houses affected; wires down causing interruption to communications. Scenes in the aftermath of the storm were described as resembling flood-torn areas in Hartford, Portland and Middletown in March when the Connecticut River got out of control.
Clarion, Iowa	17	do			5,000	Electrical	Lightning struck a church destroying the organ.
Franklin, Vernon, and Cedar Townships, Iowa.	17	do	[1] ½-2		6,000	Wind	Property damaged.
Platteville, Wis., and vicinity [2]	17	do			8,000	Thundersquall	Large barn and contents destroyed by fire and 2 calves perished; house struck.
Cedaredge, Colo	17				75,000	Hail	Much loss to apples and peach crop.
Houston, Mo.	17				1,500	Wind	Roofs, windows, trees, and power lines damaged.
Roseville, Iowa, vicinity of	18	A. m.			5,000	Electrical	2 barns destroyed by fire.
Gorman, S. Dak	18	10:30 - 11 p. m.	110	0	20,000	Tornado	Several houses, barns, and sheds blown down.
Onida, S. Dak	18	10:30-10:45 p. m.				Wind and hail	Trees and windows broken, automobile tops riddled, and outbuildings wrecked.
Union Township, Iowa	18	P. m.			25,000	Wind	Loss to crops.
Miller, S. Dak., 10 miles north	18	do				do	Several buildings and a granary wrecked.
Branson, Mo., and vicinity	18				20,000	do	Several buildings damaged, windows broken, trees uprooted, and wires down.
Sheboygan and Milwaukee Counties, Wis.	18				10,000	do	Buildings demolished; poles and trees down.
Van Buren, Des Moines, and Muscatine Counties, Iowa.	19	P. m.			16,570	Wind and hail	Property damaged; loss to crops.
Buffalo, N. Y., and vicinity	19	do			15,000	Thunderstorm	In many sections of the city electric service was interrupted; viaducts and cellars flooded by the sudden downpour; 2 barns destroyed by lightning.
Edinboro and Meadville, Pa.	19	do		0	100,000	Tornado	Trees uprooted, barns destroyed and telephone lines damaged.
Lebanon, East Palestine, Bellefontaine, Bucyrus, and Brookville, Ohio.	19			4		Thunderstorm and hail.	4 persons killed by lightning; hail reported at Brookville.
Miami and Safford, Ariz	19-20				2,000	Wind and rain	Damage to streets and power lines.
Formosa, Kans., 3 miles south	20	4:30 p. m.	1,320	0	10,000	Tornado	Barns and other farm buildings damaged or demolished; path 8 miles long.
Elk City to Washington, Nebr.	20	6:15 p. m.	400	0	10,000	do	No details.
West Blockton, Ala.[2]	20	P. m.				Wind, rain, and hail.	Baggage section of a railroad station wrecked, 6 houses unroofed and trees blown down.
Bright Angel Canyon, Ariz	20				50,000	Cloudburst	A 16-foot wall of water sent down the canyon damaging the North Rim Water System and the Kaibab Trail.
Chickasaw and Clayton Counties, Iowa.	20				3,060	Wind, electrical	Barn and contents destroyed by fire; grain blown down.
Horton, Kans., vicinity of	21	3 p. m.		0	200	Tornado	Funnel cloud observed, but apparently did not reach the ground.
Pottawattamie County, Iowa	21	4 p. m.	440		7,000	Wind	Property damaged; loss to crops.
Lucas County, Iowa	21	5-6 p. m.			2,200	do	Buildings damaged; loss to crops in scattered areas.
Wichita, Kans	21	P. m.			2,000	Thundersquall	Buildings damaged.
Bethany, Cameron, Forest City and Oregon, Mo. and vicinity.	21					Wind	Property damaged and wires down.
LakeMonona and Racine, Wis	22	12-1 a. m.	[1] 1		15,000	Thundersquall	Roofs of 4 silos blown off, shed demolished and trees and poles down.
West Bend, Wis., vicinity of	22	12:10 a. m.		0		Tornado	Garage completely demolished, but car left intact; silo blown over, the corner of a barn roof blown off and a few smaller buildings damaged.
Monroe County, Iowa	22	3 p. m.			1,000	Wind	Property damaged.
Clinton County, Iowa	22	3:30 p. m.	2,640		3,500	do	Property damaged; corn blown down; livestock killed.
Adair County, Iowa	22	4:30 p. m.	[1] 1		1,000	Wind and hail	Loss to crops.
Davis County, Iowa	22	5 p. m.			2,100	Wind	Property damaged.
Jackson County, Iowa	22	6 p. m.	1,056		17,000	Wind and hail	2 barns, garage, and machine shed wrecked; several cows, hogs, and many chickens killed; loss to crops.
Jasper County, Iowa	22	6:30 p. m.			15,000	Thundersqualls	Corn blown down; several small buildings wrecked; fires in vicinity of Newton and Baxter caused by lightning.
Poweshiek County, Iowa	22	6:30 p. m.			2,500	Hail and wind	Property damaged; loss to crops.
Marshall County, Iowa	22	7 p. m.			18,000	Wind	Crop loss $17,000; property damage $1,000.

[1] Miles instead of yards.

[2] From press reports.

TABLE 3.—*Severe local storms, August 1936*—Continued

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Des Moines County, Iowa	22	9 p. m.			$2,600	Wind and hail	Property damaged.
Scott County, Iowa	22	...do.			700	Wind	Corn blown down; property damaged.
Chicago, Ill.[2]	22	P. m.				...do.	Several persons injured, trees uprooted, porches collapsed and awnings ruined. 10 persons rescued from overturned sailboats on Lake Michigan.
Monmouth, Ill., vicinity of	22				3,000	...do.	Property damaged.
Fayette County, Kans., southern section.	22			2		Tornado	2 tobacco barns blown down.
Grand Rapids, Mich., and vicinity.	22					Thundersquall	Considerable damage to trees, telephone and power lines; much damage to farms south of the city.
Fort Worth, Tex	23	4 p. m.			20,000	Wind	No details.
Greenville, Tex	23	...do.	880	0		Tornado	Do.
Asheville, N. C.[2]	23	P. m.				Rain, hail, and snow.	Hail and snow found in drifts and in many places was reported to be from 4½ to 6 inches deep; corn leveled and uncovered flower beds damaged.
Rochester, Geneva, Waterloo, Seneca Falls, and Walcott, N. Y.	23			5	130,000	Severe thundersqualls.	Houses and barns unroofed; several tourist cabins wrecked and 9 persons injured; much damage to trees and public utility lines; loss to vineyards and crops.
Benton County, Iowa	24	8 p. m.			1,500	Wind	2 barns unroofed; corn flattened.
Ripley and Clarksdale, Miss., vicinity of.	24			1		Thundersquall	Valuable barn and contents burned and 10 persons seriously injured.
Marshall, Tama, Iowa, Johnson, Washington, and Louisa Counties, Iowa.	25	2-6 p. m.	[1] 2-10		100,000	Wind, rain, and hail.	A series of storms occurred along a path from Marshall and Tama Counties southeastward to the northern part of Louisa County. Crop loss and property damaged; path 50 miles long.
Clarke County, Va	25	4 p. m.	[1] 1		75,000	Heavy hail	Loss mostly to apple crop.
Clinton County, Iowa	25	9 p. m.	[1] 2		10,000	Wind	Loss to crops.
Sea Girt, N. J.[2]	25	10:15 p. m.				Wind and electrical.	Tents of the National Guard regiments destroyed or scattered.
Mercer County, Pa	25					Wind, rain, and hail.	Many trees uprooted, property damaged and wires down.
Milwaukee, Wis., and vicinity	25				30,000	Thundersquall and hail.	Lightning struck a chimney in the County Emergency Hospital shocking a nurse and several patients. Hail punctures automobile tops and damaged greenhouses; fruit blown from trees.
Waushara and Adams Counties, Wis.	25				43,000	...do.	Barn and several silos blown over; buildings damaged; trees uprooted. Crop loss $25,000.
Bradshaw and Charleston, Nebr.	26	7:10 p. m.	[1] 1		6,000	Wind and hail	No details.
Springfield, S. Dak	26	11:30 p. m.	[1] 1		5,000	Hail	Roofs riddled, windows broken; path 3 miles long.
Morrison, Ill	26					Electrical	2 large barns and contents burned.
Outagamie and Winnebago Counties, Wis.	26				5,000	Hail	Crop loss considerable; property damage estimated at $5,000.
Sioux and O'Brien Counties, Iowa.	26-27	10 p. m.-1:30 a. m.			100,000	Wind and hail	A series of hailstorms accompanied by squalls; property damaged.
Santee, Nebr	27	2 a. m.	[1] 2		5,000	Hail	No details.
O'Brien, Cherokee, Dickinson, Emmet, Palo Alto, Calhoun, Clay, and Buena Vista Counties, Iowa.	27	5:30-7 p. m.			12,000	Wind and hail	Corn flattened and other crop loss; trees uprooted; wires down and property damaged.
Woodbury and Monona Counties, Iowa.	27	6 p. m.			5,000	...do.	Damage to houses, wires, and farm property; loss to crops.
Hancock, Wright, Hamilton, Cerro Gordo, Franklin, and Hardin Counties, Iowa.	27	6-10 p. m.			150,000	Wind, rain, and hail.	Storm centered in the northeast portion of Wright County and extended north and east into Hancock and Cerro Gordo Counties. Much damage from wind. Crops blown over and beaten down by heavy rain and hail, 4.50 inches of rain fell in 2 hours causing much flooding and erosion. A highway underpass was flooded to a depth of 4 feet. Many windmills blown down, roads blocked by fallen trees and many cars stalled. There was some indication of a twisting wind in the wreckage of buildings.
Chickasaw County, Iowa	27	9 p. m.			2,500	Wind	Property damaged and chickens killed.
Keokuk County, Iowa	27	...do.			5,200	...do.	Barn wrecked, 3 cattle and a hog killed; path narrow.
Tama County, Iowa	27	9 - 10:30 p. m.			5,000	Wind and hail	Loss to crops.
Grundy County, Iowa	27	10 p. m.			10,000	...do.	Crop loss; property damaged.
Monticello, Ill	27				1,100	Wind	Property damaged.
Clayton and Dubuque Countes, Iowa.	27-28				2,500	Wind, electrical	Barn destroyed, 3 others fire occurred.
Worth County, Iowa	28	2 a. m.			7,500	Wind	Buildings damaged; stock killed.
Vigo to Wayne Counties, Ind., and vicinity.	28	4-7:30 p.m.		1	600,000	Wind, electrical	At Terre Haute damage of $600,000 reported. Boy killed and 4 others injured when a tree blew down on a tent in which they were playing.
Dayton, Ohio, and vicinity	28	P. m.		1	7,500	Thundersquall	Farmer killed when a corncrib blew over on him; trees uprooted many falling on buildings doing much damage; fire destroyed a dairy barn with loss estimated above.
Walhalla, S. C	28	...do.			1,000	Thunderstorm	Several garages blown down, roofs damaged and trees twisted.
Clinton, Ill	28				2,500	Electrical	House burned.
Divernon, Ill	28				500	Wind	Property damaged.
Lunenburg County, Va	29	5:30 p. m.	[1] 4		60,000	Hail	Crop loss $50,000; property damage $10,000.
Wilmington, N. C., vicinity of.	29	P. m.			500	Thunderstorm	Tidewater Power Co. damaged and power service interrupted; lightning made large blazes on 4 pine trees, burrowed beneath a walk and emerged on the other side.
Grand Canyon, Ariz	29				500	Rain and hail	Storm left hail to the depth of 3 inches.
Lincoln, Ill	29				15,000	Thundersquall	Property damaged.
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Urania, La	2	2:15 a. m.	100		$750	Wind	Property damaged.
Sentinel Butte Pass, Mont	5	P. m.		0		Tornado	Several small outbuildings destroyed; amount of damage not estimated.
Billings, Mont	6	4:15 - 4:30 p. m.			1,500	Wind	Airplane partially destroyed.
Wilmington, Minn	12	2-3 p. m.	880	0	5,000	Tornado	Outbuildings and silos demolished; trees uprooted; loss to corn crop.
Underwood, Minn., and vicinity.	13	7:30-8 p. m	1,320		1,500	Thundersquall	A number of small buildings; garages, silos, and windmills wrecked; houses damaged; poles and wires down; trees uprooted.
Upper Bitter Root Valley, Mont.	14	6:45 p. m.				Hail	Orchards and property damaged; considerable loss in poultry; amount not estimated.
Norwood, Minn., and vicinity	15	5:40 p. m.	1,320	0	11,000	Tornado	Rotary wind reported; large barn, number of small buildings and silos demolished; automobile blown off the road; 1 person injured; path 10 miles long.
Sheridan County, Mont., northern portion.	17	7:30 p. m.	[1] 3-6		51,500	Hail	Crop loss estimated at $50,000; path 15 miles long.
Nobles and Jackson Counties, Minn.	19	3-4 p. m.	[1] 10		75,000	Thundersquall	Number of barns, outbuildings, silos, and windmills demolished; houses, garages, and town buildings damaged.
Highwood, Mont., 7 miles northeast.	24	4:30 p. m.	20	0	1,500	Tornado	Property damaged; path 2 miles long.
Helena, Mont	24	7:25 p. m.			700	Wind	Property damaged.
Silver Bow County, Mont	26				7,000	Cloudburst	Damage to roads and highways; loss to hay and crops.

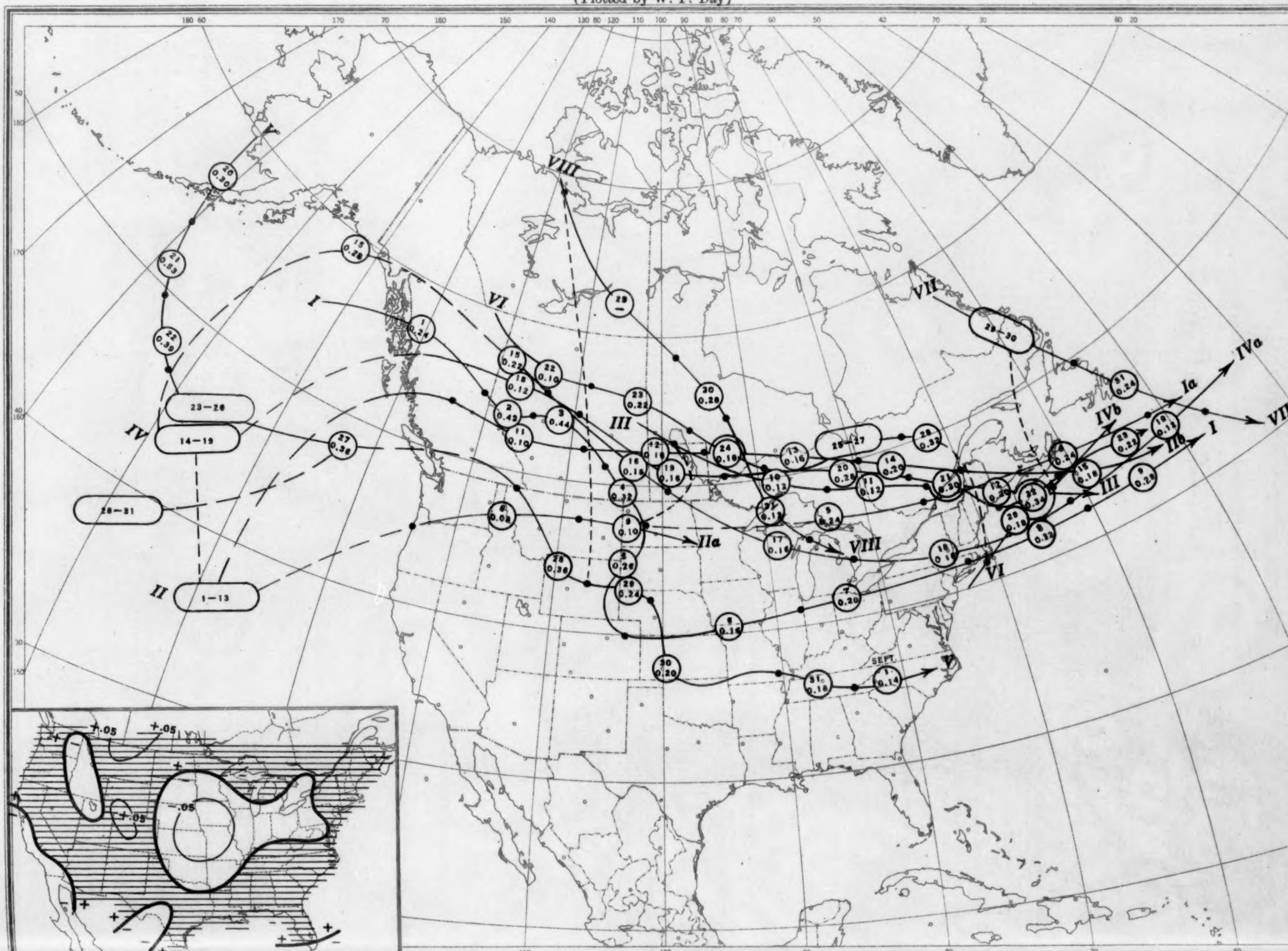
[1] Miles instead of yards.

[2] From press reports

Chart I. Departure (°F.) of the Mean Temperature from the Normal, August 1936

Chart II. Tracks of Centers of Anticyclones, August 1936. (Inset) Departure of Monthly Mean Pressure from Normal

(Plotted by W. P. Day)



Circle indicates position of anticyclone at 8 a. m. (75th meridian time), with barometric reading. Dot indicates position of anticyclone at 8 p. m. (75th meridian time).

Chart III. Tracks of Centers of Cyclones, August 1936. (Inset) Change in Mean Pressure from Preceding Month

(Plotted by W. P. Day)

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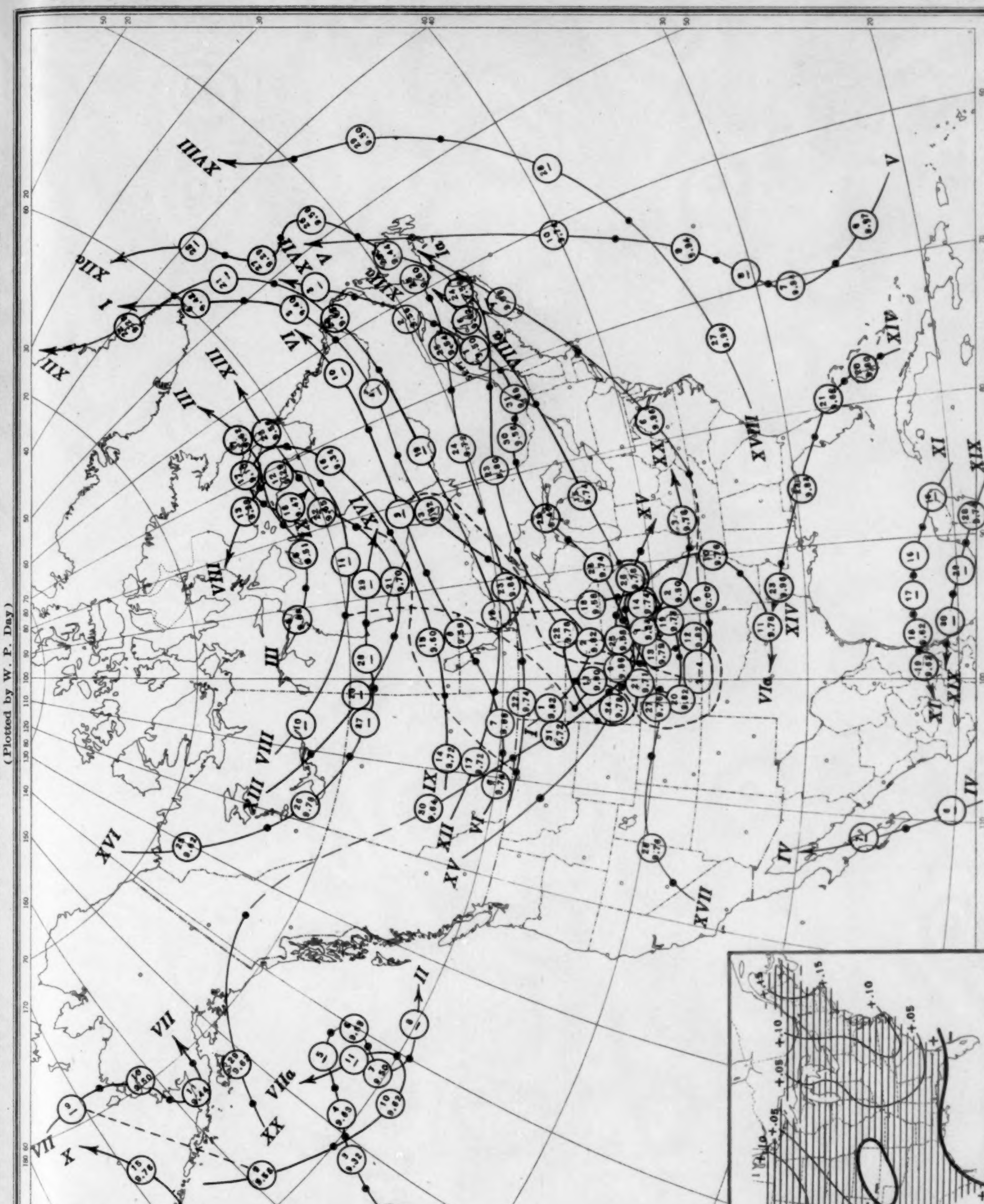
(Plotted by W. P. Day)



Circle indicates position of anticyclone at 8 a. m. (75th meridian time), with barometric reading. Dot indicates position of anticyclone at 8 p. m. (75th meridian time).

Circle indicates position of cyclone at 8 a. m. (75th meridian time), with barometric reading. Dot indicates position of cyclone at 8 p. m. (75th meridian time).

Chart IV. Percentage of Clear Sky Between Sunrise and Sunset, August 1936

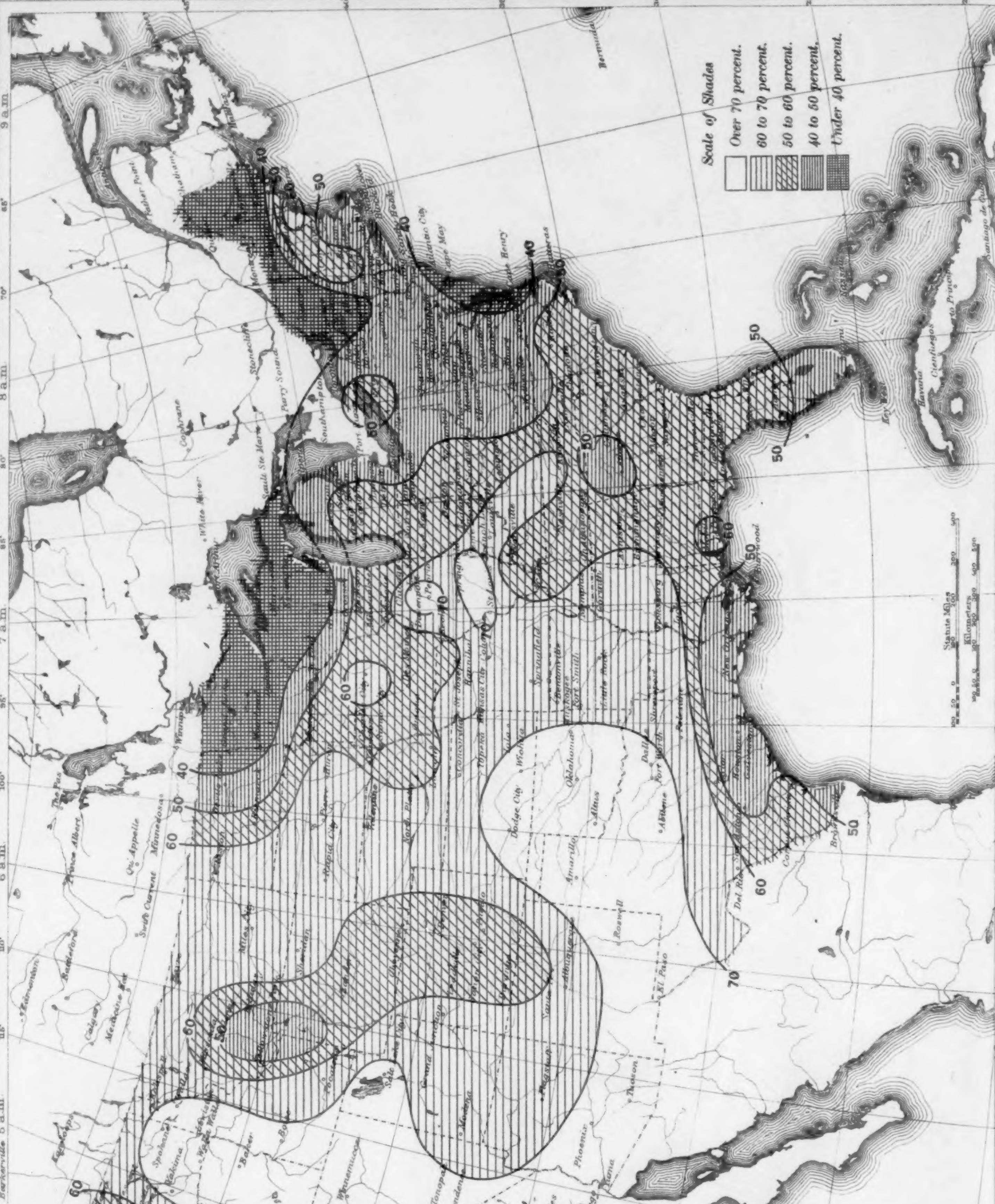


Chart V. Total Precipitation, Inches, August 1936. (Inset) Departure of Precipitation from Normal

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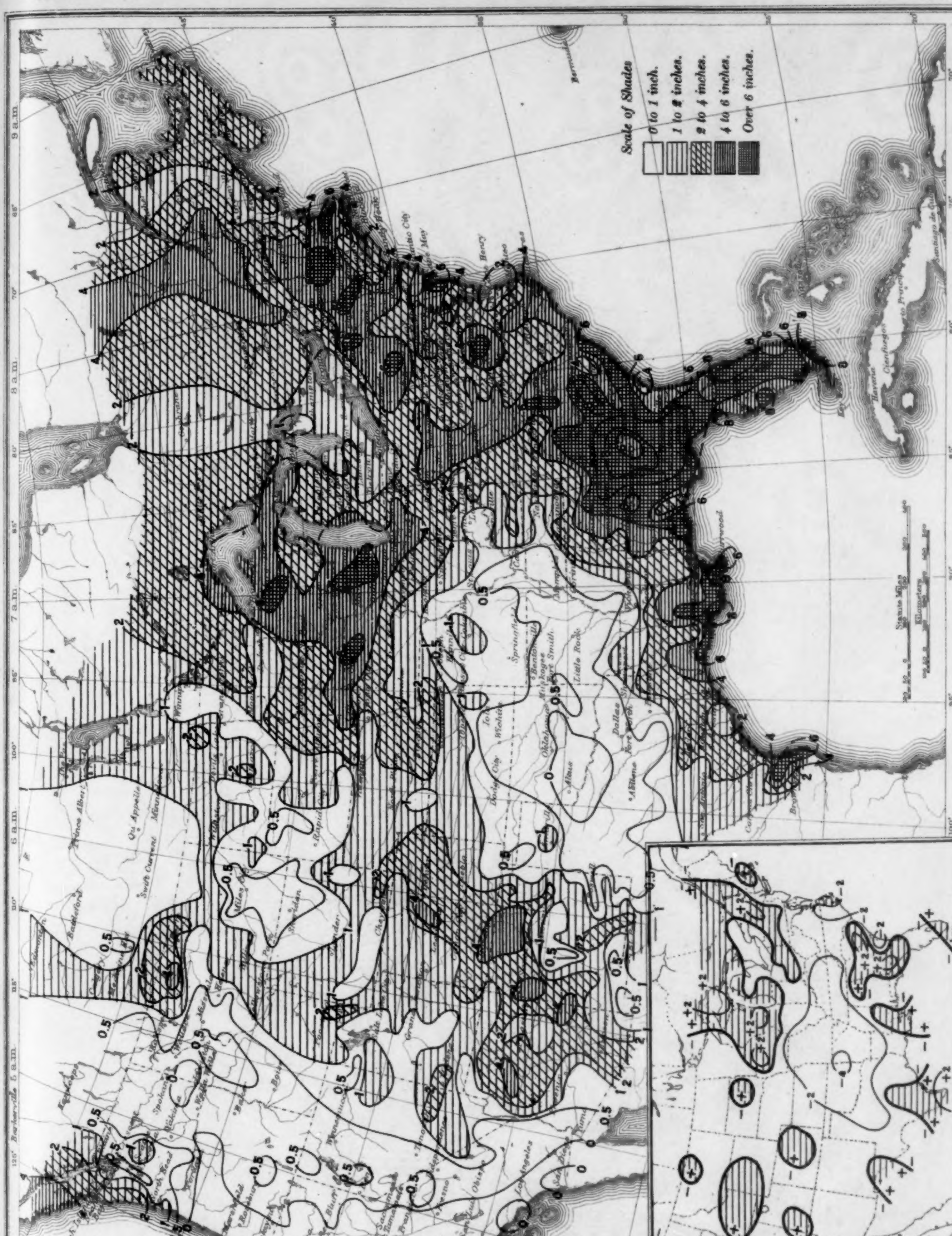

Chart VI. Isobars at Sea Level and Isotherms at Surface; Prevailing Winds, August 1936

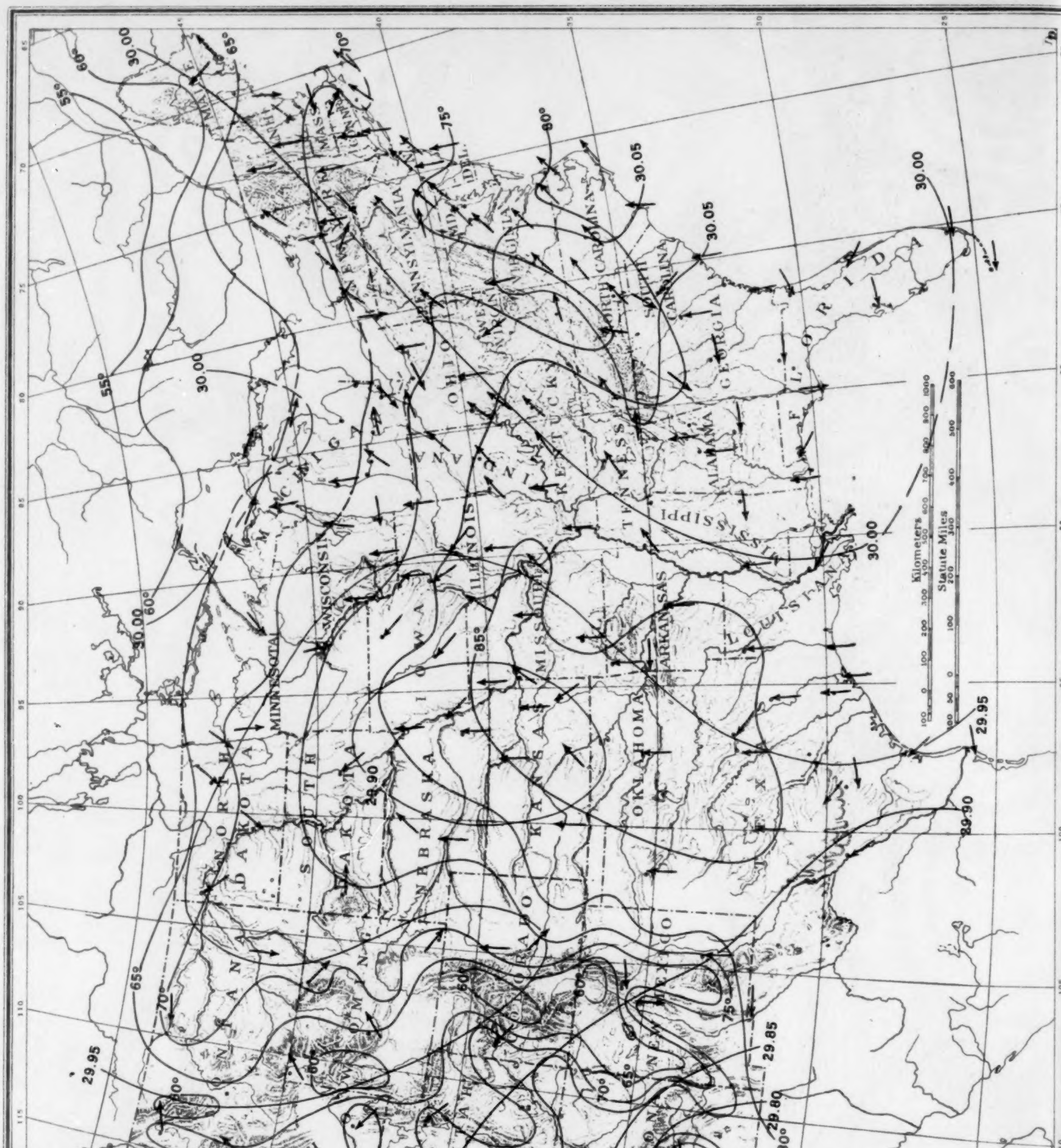

Chart VII. Wind Roses for Selected Stations, August 1936
(Plotted by W. W. Reed)

Chart IX. Weather Map of North Atlantic Ocean, August 18, 1938
(Plotted from the Weather Bureau Northern Hemisphere Chart)

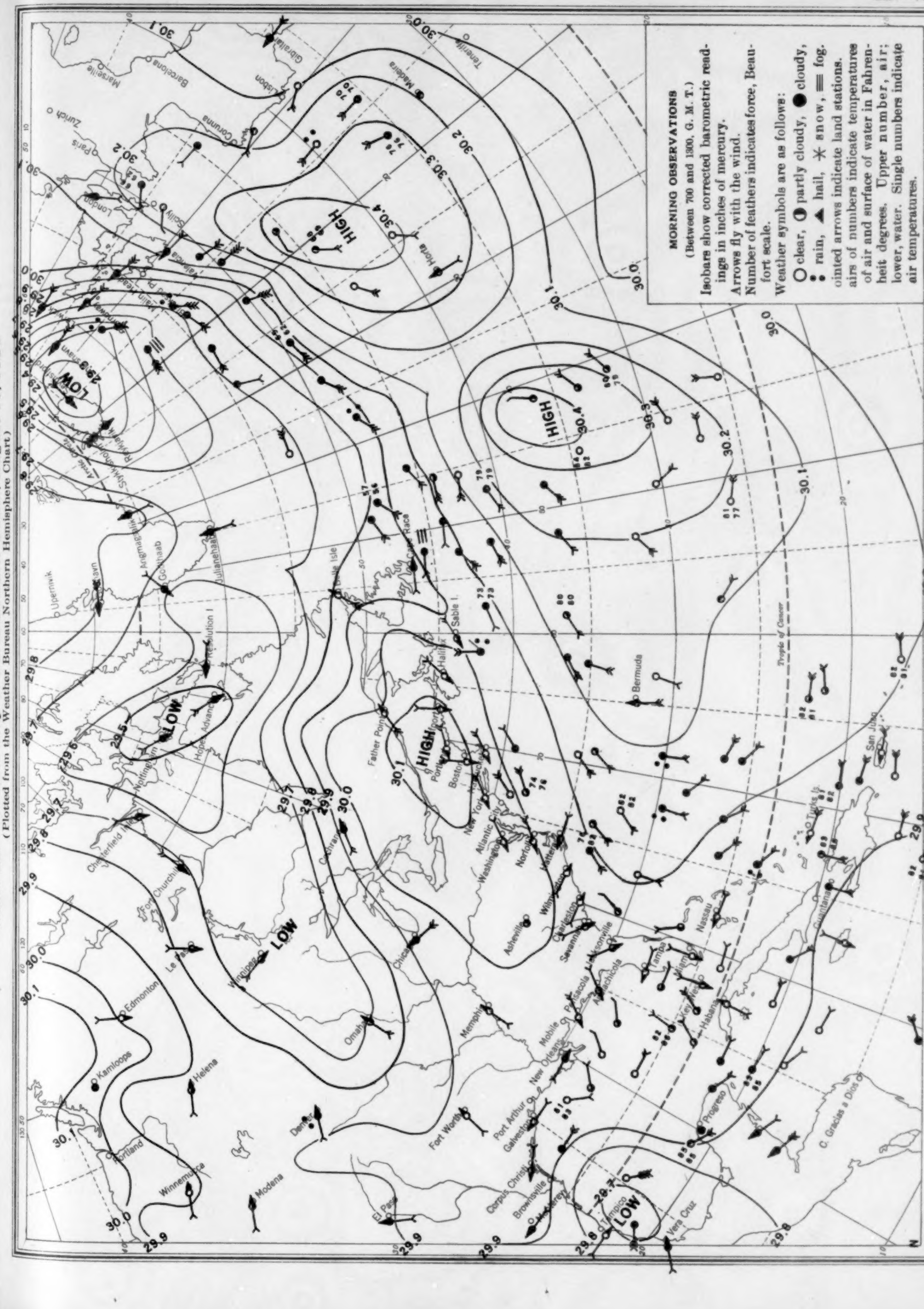

Chart IX. Weather Map of North Atlantic Ocean, August 18, 1936
(Plotted from the Weather Bureau Northern Hemisphere Chart)